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Microcomputer implementation and use for the aviation logistic support functions of the Third Marine Aircraft Wing: a case study

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MICROCOMPUTER IMPLEMENTATION AND USE FOR
THE AVIATION LOGISTIC SUPPORT FUNCTIONS
OF THE THIRD MARINE AIRCRAFT WING:
A CASE STUDY

by

Joseph F. Buranosky
and
Curtis W. Howes

March 1987

Thesis Co-Advisors: Carson K. Eoyang
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Microcomputer Implementation and Use for the Aviation Logistic Support Functions of the Third Marine Aircraft Wing: A Case Study

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ABSTRACT

The proliferation of microcomputers is a reality. During this study, we researched the implementation and use of microcomputers for aviation logistics support in the 3rd Marine Aircraft Wing. In the course of our research, we interviewed Staff Officers and other personnel involved with automation and aviation logistics support. We saw first hand how these microcomputer systems were being employed. Based upon accepted theory and current ideas regarding the use of information technology, we analyzed the methods and effectiveness of microcomputer implementation and use across the Wing. We found a high degree of variability in the implementation methods and use of microcomputer systems. A great deal of work remains to be done. We think that much of what we discovered in the course of our study is applicable across organizational boundaries within the United States Marine Corps.

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We dedicate this thesis to the memory of Major Rod Kippen, USMC. His support and enthusiasm made this effort possible.

SEMPER FIDELIS!

I. INTRODUCTION

A. GENERAL BACKGROUND

Federal agencies are currently riding high on the euphoric effects of the explosion of microcomputer technology. The idea of end-user computing, through the use of microcomputers, is permeating the entire federal establishment. The traditional idea that automated data processing is conducted exclusively at a central location is quickly becoming a tenet of the past. In 1983 there were only 7,908 microcomputers purchased by federal agencies and in 1985 there were 67,502 purchased, an 800% increase in procurement. [Ref. 1: page 1] The estimated purchases of all federal agencies for 1986 is double the 1985 figure, with an estimated 500,000 microcomputers to be in service with federal agencies by the year 1990. [Ref. 1: page 21] These figures reflect a growing dependence upon microcomputing in the accomplishment of organizational goals and objectives.

In 1983, the government contracted with Zenith Data Systems for delivery of the Z-120 computer system, and over 14,000 of these microcomputers were ordered by the Department of the Navy alone. Again, in 1984, Zenith Data Systems was awarded another contract for microcomputers and provided the Z-150 computer system. This contract provided for the delivery of over 10,000 microcomputers to the U.S. Air Force, Navy and Marine Corps for use in high security applications worldwide. In 1986 the government once more contracted with Zenith for the purchase of even more microcomputers, this time the more powerful Z-248 computer system would be supplied. An estimated 90,000 Z-248 computer systems will enter the service of the U.S. Government over the next three years. [Ref. 2]

The Zenith contracts account for a large percentage of all federal purchases of microcomputers. In 1985, 42% of all micro purchases were with Zenith or IBM, the majority of those purchases were Zenith systems. [Ref. 1: page 21] The Marine Corps has made wide use of the Z-120 and Z-150 systems purchased in the past few years and will also employ the new Z-248. The proliferation of microcomputers for end-user computing is reaching every level of the Corps.

This new technology is playing an ever increasing role as an element in the various support aspect of our nation's defense establishment. It is important to take a

serious look at the impact that the introduction and use of microcomputers has had on the military organization. The rapid assimilation of new technology requires innovation and flexibility, yet time tested methods pertaining to orderly change should not be quickly discarded. We have sought to examine the implementation of these microcomputer systems within the United States Marine Corps. Specifically, the research was conducted to assess the introduction of microcomputers and explore the impact of their use within the Third Marine Aircraft Wing (3rd MAW), focusing on the aviation logistic support aspects within the major and subordinate commands. The associated results of the study could have far reaching implications within the United States Marine Corps.

B. ORGANIZATIONAL STRUCTURE

In order to appreciate the implications for this new technology within the context of aviation logistic support, it is necessary to have a basic understanding of the mission of Marine Aviation and the structure upon which it is built. The focus of the research for this thesis was the aviation logistic support elements found at all levels of command: wing, group, and squadron.

> The primary mission of Marine Corps Aviation is to participate as the supporting air component of the FMF in the seizure and defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign. A collateral mission of Marine Corps Aviation is to participate as an integral component in the execution of such other navy functions as the fleet commander may direct. [Ref. 3: para. 1103d]

The Marine Aircraft Wing, commanded by a Major General, is the highest level tactical aviation command within the Fleet Marine Force. The MAW is subordinate to the FMF in the normal chain of command and it also falls under the purview of the naval air commander of the fleet pertaining to matters of aviation logistics, training, and support. [Ref. 3: para. 2102] The basic structure of a Marine Aircraft Wing is depicted in Figure 1.1.

Each wing is made up of smaller units called groups. A Marine Aviation Group, normally commanded by a Colonel, is an administrative and tactical command. There are basically three types of groups found within the wing: The Marine Air Control Group (MACG), the Marine Wing Support Group (MWSG), and the Marine Aircraft Group (MAG). Since the thrust of the research was directed at aviation logistics support, specifically as it relates to aircraft readiness, we were concerned primarily with

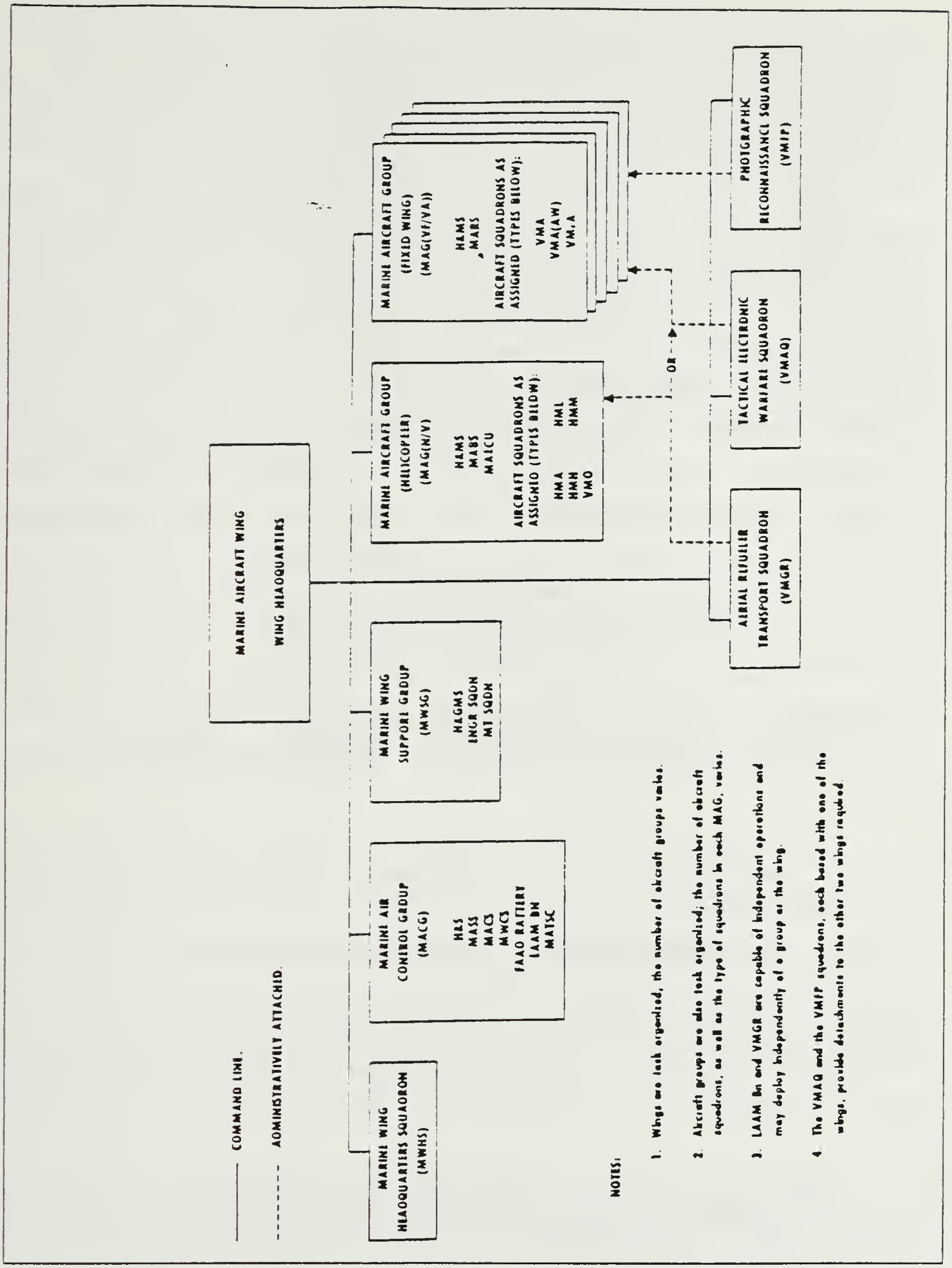

Figure 1.1 Structure of A Marine Aircraft Wing.

the MAG at this level of the organization. The Marine Aircraft Group is task organized on the basis of its assigned mission and is designed for independent operations with no outside assistance except for a source of supply. There are currently two types of groups - fixed wing and helicopter. [Ref. 3: para. 2103]

Each group is in turn broken down into individual squadrons, normally commanded by a Lieutenant Colonel; the squadron is the lowest administrative and tactical level within Marine Aviation. There are two types of squadrons that are directly involved with aircraft maintenance and material support. The first is the aircraft squadron which is designated by the type of aircraft it flies. The following squadrons exist in Marine aviation and are formed into groups in accordance with their mission: VMFA - fighter attack, VMFP - photographic reconnaissance, VMA/VMA(AW) - attack and all weather attack, VMAQ - tactical electronic warfare, VMGR - aerial refueler transport, VMO - observation, HMH - helicopter heavy, HMM - helicopter medium, HMA/L - helicopter light/attack. These squadrons operate the aircraft, and their support elements perform organizational level maintenance.[1] The second type of squadron which performs aviation logistics support is the Headquarters and Maintenance Squadron (H&MS). In addition to providing administrative support, the H&MS provides logistic support for all units attached to the MAG. The H&MS performs intermediate level maintenance[2] on aircraft systems. [Ref. 4]

The 3rd MAW currently encompasses four MAGs and one Marine Aircraft Training Group (which also has aircraft assigned). These organizations operate from four different locations - MCAS El Toro, MCAS (H) Tustin, and MCAF Camp Pendleton all in southern California, and MCAS Yuma, Arizona. All together they maintain and operate in excess of 500 tactical aircraft of 12 different types and of various configurations. The overall wing organization is broad in scope and complex in operation. We studied the organizational structures, systems, and processes at each level of command in our attempt to assess the implementation and use of

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[1]Organizational level maintenance is that maintenance which is the responsibility of and is performed by a using organization on its assigned equipment. Its phases normally consist of inspecting, servicing, lubricating, adjusting, and replacing parts, minor assemblies, and subassemblies.

[2]Intermediate level maintenance is that maintenance which is the responsibility of and is performed by designated maintenance activities for direct support of using organizations. Its phases normally consist of calibration, repair or replacement of damaged or unserviceable parts, components, or assemblies; the emergency manufacture of non-available parts; and the provisions of technical assistance to using organizations.

microcomputers as a tool to enhance aircraft support capabilities.

In the 3rd MAW, the Aviation Logistic Department (ALD) performs those staff functions necessary to aircraft maintenance and material support. This department, headed by a Colonel, who is an assistant chief of staff reporting directly to the Commanding General, is composed of an Aviation Ordnance Section, Aviation Avionics Section, Aircraft Maintenance Section, Aviation Supply Section and an Administrative Section (see Figure 1.2). This organizational structure allows for the integration and close coordination necessary among the various facets of aviation logistics to ensure effective aircraft support. The department advises the Commanding General with regard to all matters pertaining to aviation logistics, and in turn provides support and guidance to the aviation logistic support elements at subordinate levels of command within the Wing.

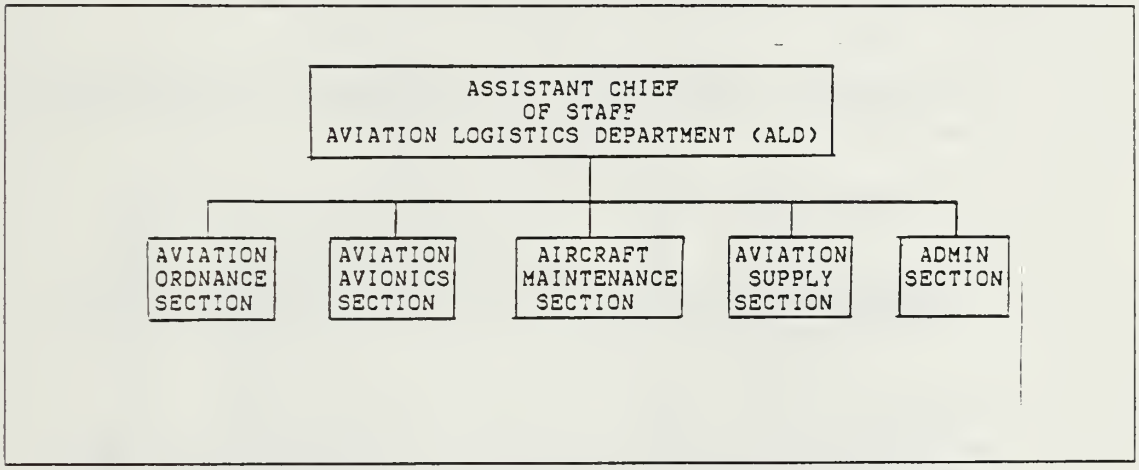
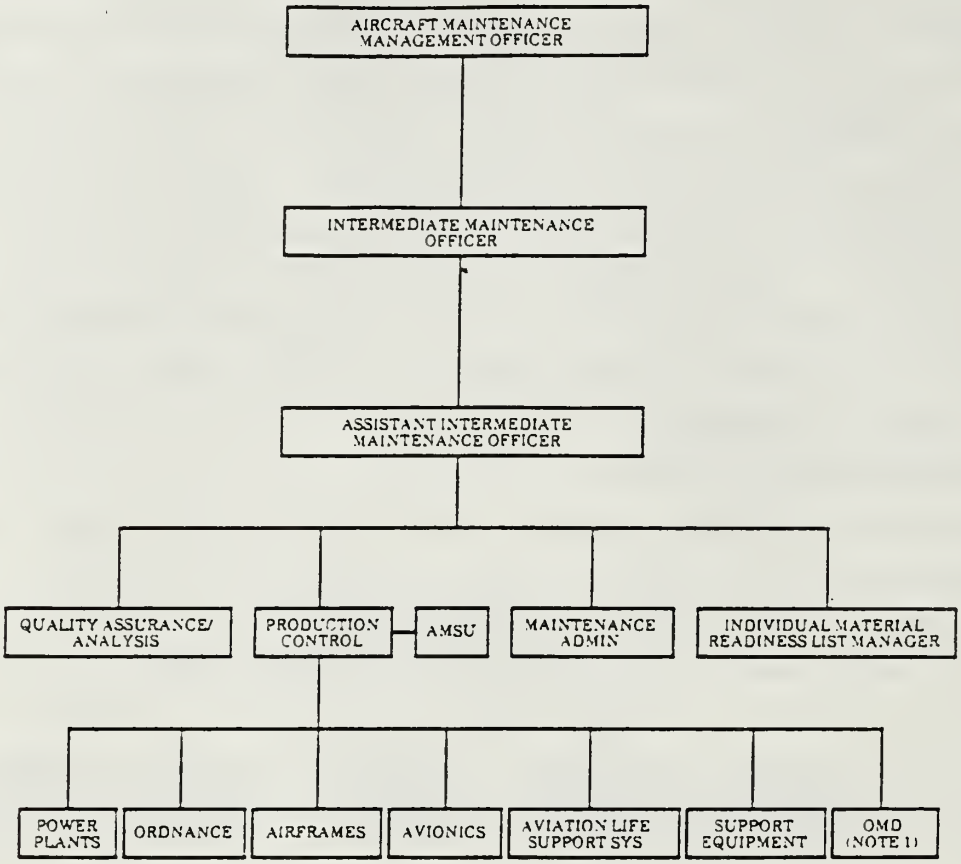


Figure 1.2 3rd MAW Aviation Logistics Department.

At the group level, aviation logistic support follows basically the same pattern with aircraft support being managed by the Group Aircraft Maintenance Management Officer, and the Group Supply Officer, who are staff officers of the Group Commander. These logistics managers direct the activity of their corresponding departments and divisions within the administrative structure of the Headquarters and Maintenance Squadron which provides a wide range of logistics support to the individual aircraft squadrons. Figure 1.3 depicts the Intermediate Level Maintenance Department Organization and Figure 1.4 the Group Supply Department Organization.

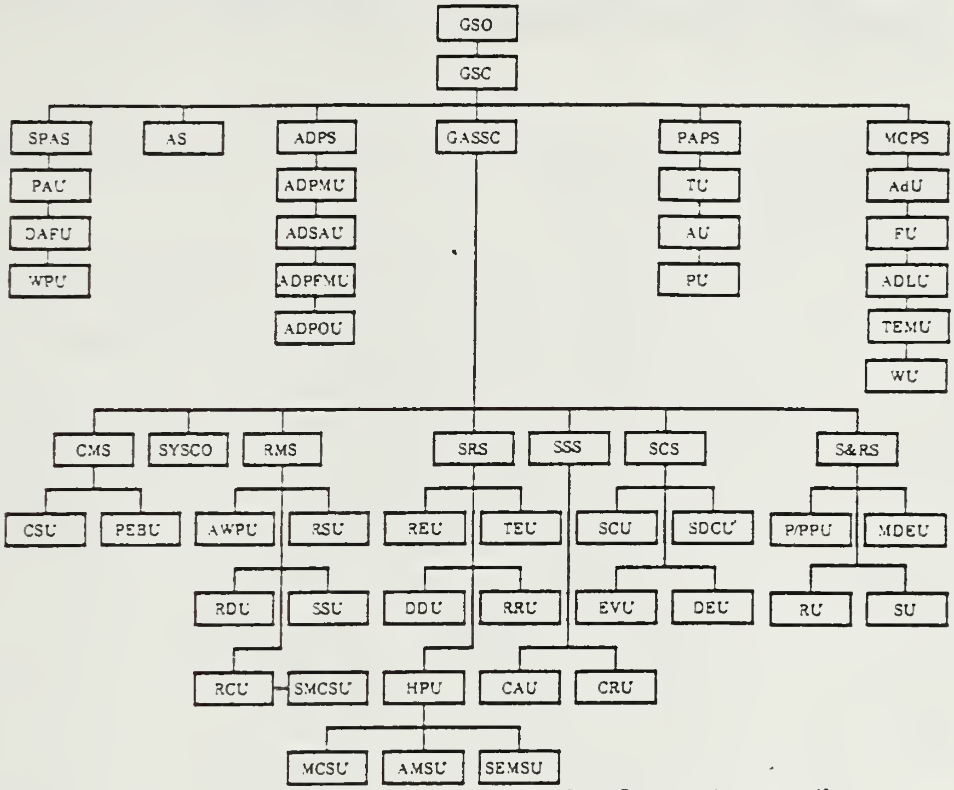


Breakdowns beyond the basic divisions are not illustrated because of the variety of branches possible. Activities will be required to establish the necessary branches in accordance with their individual requirements. Appendix D will be used as a guide to establish branches/work centers within the respective divisions. Branches should be established only when more than one work center is involved, for example, jet engine branch with work centers for J79 engine and J52 engine.

NOTE 1: When operating aircraft are assigned to the IMA, an organizational maintenance division will be established.

Figure 1.3 Intermediate Level Maintenance Department Organization.

Within each aircraft squadron, aviation logistics support is generally coordinated by the squadron Aircraft Maintenance Officer. The divisions he manages perform the basic functions of aviation logistics and work in conjunction with their counterparts in the overall logistics support structure.



ADLU	Additional Demand Listing Unit
ADPFMU	Automated Data Processing File Manager Unit
ADPMU	Automated Data Processing Maintenance Unit
ADPOU	Automated Data Processing Operating Unit
ADPS	Automated Data Processing Section
ADPSAU	Automated Data Processing SystemAdministration Unit
AMSU	Aircraft Monitoring Sub Unit
AS	Accounting Section
AdU	Administration Unit
AU	Audits Unit
AWPU	Awaiting Parts Unit
CAU	Customer Assist Unit
CMS	Consumable Material Section
CRU	Custody Records Unit
CSU	Consumable Stocking Unit
DAFU	Directives and Files Unit
DDU	Document Distribution Unit
DEU	Data Entry Unit
EVU	Edit Verification Unit
FU	Fiscal Unit
GASSC	Group Aviation Supply Support Center
GSC	Group Supply Chief
GSO	Group Supply Officer
HPU	High Priority Unit
MCPS	Marine Corps Property Section
MCSU	Maintenance Coordinator Sub Unit
MDEU	Material Delivery Expediting Unit
PAPS	Plans and Programs Section
PAU	Personnel Administration Unit
PEBU	Pre-expended Bin Unit
P/PPU	Packing, Preservation & Packing Unit
PU	Projects Unit
RCU	Repairable Control Unit
RDU	Repairable Delivery Unit
REU	Requisition Expediter Unit
RMS	Repairable Material Section
RRU	Requisition Reconciliation Unit
RSU	Repairable Storage Unit
RU	Receiving Unit
SCS	Stock Control Section
SCU	Stock Control Unit
SDCU	Supply Data Communication Unit
SEMSU	Support Equipment Monitoring Sub Unit
SMCSU	Special Material Control Sub Unit
SPAS	Supply Personnel Administration Section
SRS	Supply Response Section
SSS	Squadron Support Section
SSU	Supply Screening Unit
SU	Shipping Unit
SYSCO	System Coordinator
S&RS	Shipping & Receiving Section
TEMU	Table of Equipment Management Unit
TEU	Technical Edit Unit
TU	Training Unit
WPU	Word Processing Unit
WU	Warehousing Unit

Figure 1.4 Group Supply Department Organization.

The organization for aviation logistics support within the wing has a framework that provides for integration of all logistic arenas, and it is based upon a plan for dynamic aircraft maintenance and material management. The Naval Aviation Maintenance Program (NAMP), OPNAVINST 4790.2D, delineates the structures, functions, and procedures necessary to maintain naval aircraft readiness.

The objective of the Naval Aviation Maintenance Program (NAMP) is to achieve the aviation material readiness standards established by the Chief of Naval Operations (CNO), with optimum use of manpower, material, and funds. [Ref. 5: para. 2.1.1]

To this end the NAMP has evolved over the years to support naval aircraft in a changing operational environment.

Any effective plan for aircraft support must be based upon an adequate management information system that allows for timely collection and processing of data and the dissemination of resultant information needed for management action. The baseline management information system that was, and still is to a large extent, in use at the organizational (aircraft squadron) and intermediate (H&MS) levels of maintenance and also within the supply support arena is made up of a mix of manual and partially automated systems. Those who have worked with the system admit that it is unsatisfactory given the context of today's operational scenario characterized by increasing aircraft complexity, decreasing personnel ceilings, tightening controls on high cost assests, the growing need for more information at all levels, and the continuing austere funding environment. These deficiencies have been a matter of concern to the Navy for a number of years, and the early 70's saw the genesis of a program called NALCOMIS (Naval Aviation Logistics Command Management Information System) which was deemed necessary to prevent gross inefficiencies in Fleet aviation material production and supply support. [Ref. 6: pages A3-A4] There have been a number delays in bringing this program on line, but installation of the necessary hardware is proceeding at 3rd MAW. The automated functions envisioned for this system will be designed to meet the needs of the different levels of maintenance and will include: database maintenance, flight activity, maintenance activity, configuration status accounting, personnel management, asset management, material requirements monitoring, supply support center, local/upline reporting, system support, data offload/onload, and source data automation. [Ref. 6: para.8.5.2] The development of software packages to support the scope of these planned capabilities is ongoing and will not be fully realized until sometime in fiscal year 1992, if current projections hold true. The size and complexity of NALCOMIS is evident not only in the proposed software, but also in the extent of the hardware components that make up the system. The hardware package is comprised of four subsystems: central processor subsystem (CPS), mass storage subsystem (MSS), local peripheral subsystem (LPS), and remote

peripheral subsystem (RPS). [Ref. 6: page II-17] The whole package is designed to be completely deployable when it is fully on line.

The spring of 1985 saw the arrival of the first wave of microcomputers delivered to the wing; however, the use of personally owned equipment had been going on for some time. With the promise of NALCOMIS largely unfulfilled, these systems provided an effective tool to enhance the management capabilities of those involved with aviation logistics support. Their use throughout the wing in this arena complements the envisioned capabilities of NALCOMIS, and in many ways seems to duplicate them. The thrust of this research was directed at the implementation and use of the microcomputer and its role as a management tool within the present aviation logistics support arena. The use of this tool within any management system calls for a careful analysis of its capabilities and the requirements it is assigned to fulfill. Maximum benefit is achieved when all facets of the organization realize its full potential and work within a system governed by shared capability and effective development effort. Our study focussed on the implementation of microcomputers within the aviation logistic support structure of the 3rd MAW and looked at the impact that they will have on the structure and behavior of the organization.

C. METHODOLOGY

The research was designed as a case study so we could present the different methods of implementation used at all levels of the wing organization, assess the effectiveness of the various approaches to microcomputers, and make recommendations based upon our findings and established theory. We conducted our study over a period of five months, traveling to Southern California on three separate occasions and visiting Third Marine Aircraft Wing units located at Marine Corps Air Station El Toro, Marine Corps Air Station Tustin and Marine Corps Air Facility Camp Pendleton in order to gather data and interview personnel. The use of field interviews was stressed to gain insight into the study. Two separate models provided structure for the study: a general model of Computer Systems Development [Ref. 7: pages 21-31] and the Open Systems Theory of Management. [Ref. 8]

In order to begin the research, we developed points of contact at the Third Marine Aircraft Wing and established a liaison with the Wing Aviation Supply Officer who was enthusiastic and supportive of the suggested study. We made our first trip to MCAS El Toro on 9 May 1986 and the Wing Aviation Supply Officer made

arrangements for us to meet the Assistant Chief of Staff for Aviation Logistics. We obtained his approval to conduct our research and were authorized to make whatever contacts were necessary to proceed with our research. We also made contact with the Information Systems Management Officer of the Third Marine Aircraft Wing and he provided us with the names and locations of all subordinate Information Systems Coordinators in the Marine Aircraft Groups that were to be included in the study.

Because of the large number of systems that are being used throughout the wing, it would have been extremely difficult to talk with all of the microcomputer users. We developed a questionnaire in conjunction with the Information System Coordinators (ISC) of the groups in the study. The questionnaire was designed to gather information about the implementation and use of microcomputers in each group, not to collect data for statistical analysis (see Appendix A). We made our second trip to Southern California on 31 July 1986 and distributed the surveys under a cover letter from the Assistant Chief of Staff for Aviation Logistics. We again discussed the questionnaire with each ISC, and requested that the completed surveys be returned by 30 August 1986.

The majority of the questionnaires(approximately 75%) were returned by the 15th of September 1986. The data were tallied and summarized by the 20th of the same month, and it was determined that many questions still needed to be answered - questions that arose as a direct consequence of summarizing the collected data. Therefore, on the 23rd of September 1986 we made a third and final trip to conduct more field interviews. On this trip we focused our attention on the job of interviewing the Information System Coordinators and the Maintenance and Supply Officers of each group. We returned from our third trip on 25 September 1986 prepared to write and analyze the case.

D. CASE STUDY MODELS

1. Open Systems Model

We selected the Open Systems Approach as the main model for the basis of our study. Additionally, we used a general model of computer system development and implementation. The models provided a theoretical basis for the case study.

The Open Systems Approach recognizes the fact that there are several key components of a system: environment, people, organizational structure, technology, and processes or activities of the system. This approach attempts to optimize the total

system by recognizing and representing the complex interactions and interrelationships an organization has with its environment, other organizations and with itself. The structure and technology of the organization are each composed of a multitude of subsystems. Each of these subsystems is a part of the total system. By using the systems approach, we are able to look at each subsystem and assess its strengths and weaknesses as it stands alone. We are also able to analyze the synergistic effects of combining the subsystems into the whole system. The Open Systems approach provides a logical, adaptive, and interdisciplinary framework for analysis.

The Marine Aircraft Groups of the Third Marine Aircraft Wing are considered subsystems of the larger system. That is they are integeral parts of the system known as the Wing. They interact as parts of a process that provides a vital service to the United States of America; together their synergistic effects optimize the larger systems assets. These same Marine Aircraft Groups, left to their own direction, may in fact optimize their particular goals, but at the same time they could possibly contribute to the suboptimization of the larger system. The Marine Aircraft Groups all have aviation logistic support elements that contribute to the accomplishment of the goals of the organization. Their functions are vital to the sustained combat readiness of the Third Marine Aircraft Wing.

Within each Group's aviation logistic support structure, there are at least ten Zenith computer systems. These systems are part of the technological system of the organization. The Zenith Computer Systems are subsystems of each of the aircraft groups and are integeral to their mission accomplishment.

2. Computer System Development and Implementation Model

We used a general model of computer systems development and implementation as a basis for the detailed analysis of our study. This model was taken from *Business Computer Systems, An Introduction*, by David M. Kroenke. [Ref. 7: pages 21-31] The model has four basic stages: Requirements stage, Alternative stage, Design stage and Implementation stage.

In the requirements stage the problem is identified and defined. This is necessary to see if it can be solved by, or is a candidate for automation. Once the problem is defined then specific requirements must be developed for the new system. These requirements must be realistic and should be formed with the input of the users who would employ the system. After the delineation of the specific requirements, the feasibility of the problem being solved by automation is examined from three different

aspects. The first aspect addresses the point of technical feasibility, that is does the necessary technology currently exist, or does it need to be developed? The next aspect to be considered is the cost effectiveness of solving the problem with automation, even if the technology exists. The type and size of computer system must be estimated in order to provide accurate data for this part of the feasibility evaluation. The last aspect that must be considered concerns time, that is, does the problem that is being examined require an immediate fix, or do the time constraints allow for the proper development of a well-defined computer system. Once the problem has been identified, the specific requirements developed and the feasibility evaluation completed, then managerial approval is sought for the continuance or termination of the development effort.

Assuming that managerial approval has been obtained, the system development process continues with the alternative evaluation stage. In this stage various alternatives are developed that will satisfy the original problem. The different types of hardware configurations that are available are considered along with the necessary programs, data, people and procedures. The objective of this stage of the computer system development is to identify or develop at least three or four workable alternatives that will accomplish the mission. Once the alternatives are selected as possible solutions, they are ranked according to the net benefits they would provide the organization. An alternative is selected and submitted to higher authority for approval; if approved, the development process continues.

The next stage of the procedure is the design stage. In this phase the actual specifications for needed equipment are detailed and it is ordered from the vendor. The particular programs to be run are specified and the data structure is depicted. Additionally, the personnel and procedures for the selected alternative are also clearly delineated. Finally, approval from higher authority is again sought and, if obtained, the development process continues into the implementation stage.

The implementation stage is the last step in the computer system development and implementation model. There are three main tasks that must be completed in this stage: construction of the system, testing of the completed system and actual installation. The installation of the system pertains to the actual physical hardware configuration and the loading of the operating system. Files are built or brought in and necessary documentation is written or delivered. Personnel are hired and or trained for the operation of the complete system, or arrangements are made for the

necessary system support. The system is tested as a complete entity and each component or subsystem is also tested independently. Once the system is tested and validated it can be installed for actual operation. There are four major strategies pertaining to system installation: one can plunge forward, operate in parallel, pilot the new system on part of the problem or phase in the new system. The plunge method is dangerous and not recommended. The parallel method is expensive, but does provide a back-up capability if the new system develops unexpected problems. The pilot method will minimize damage to the data and or organization if the new system is not operating correctly. The phased strategy is good if time allows for the incremental institution of a new system. Which ever strategy is selected is dependent upon the parameters of the problem and the current situation.

In the analysis of the case we have utilized the open systems approach to problem solving and have applied the above general computer system development and implementation model as a substructure of our study.

E. CURRENT TECHNOLOGIES

1. Hardware

Prior to proceeding with the discussion of the case, we present a brief overview of the state of current technology in the world of automated data processing; this may be helpful to better understanding the case and subsequent analysis. Computers are generally classified by the size of their central processing unit (CPU) main memory. Microcomputers have 32,000 to 1 million bytes of main memory and operate at approximately 250,000 instructions per second. Minicomputers have 2 million to 8 million bytes of storage space in main memory and they operate at speeds up to 4 million operations per second. Mainframe computers are large and sophisticated; they have from 8 million to 32 million bytes of storage in main memory and operate at rates of 8 to 16 million operations per second. [Ref. 7: pages 46-50] There is also a family of "super" computers that have their capabilities measured in billions of operations per second. The price of a computer may vary from several hundred dollars to 10 million or more depending on its classification and capability. There are many peripheral devices that are often attached to the main computer to enhance its capabilities. When we talk about a computer system we are also concerned with any peripheral devices attached to augment its capacity. Peripherals may include storage devices such as disk drives and tape drives; output devices such as printers and

video display terminals (VDT); and input devices such as keyboards, disk drives, tape drives, card readers, and optical scanners. There is a variety of equipment available on the market so there are countless possibilities for system configurations. We have focused our efforts on system configurations represented by the Zenith microcomputer family.

Microcomputers typically have either an 8 bit processor or a 16 bit processor; this is a standard by which they can be classified. The 8 bit processor implies a limited number of instructions, but the 8 bit processor is simple, easy to learn and adaptable to a changing environment. The number of different instructions that a microcomputer can execute is directly related to the bit size of its processor. The 16 bit processor, therefore, is capable of executing a greater number of instructions than the 8 bit processor. Additionally, the 8 bit processor has a limited amount of directly addressable space in the cpu. The 16 bit processor is more robust and has more addressable space. These two types of processors require different operating systems to help manage the assets of the computer system. In addition to the 8 and 16 bit processors, a new 32 bit processor is now being delivered to the market. Advances such as this will greatly enhance microcomputer capability. The growth of technology in microcomputer capacity may one day soon eclipse the capability of the minicomputer; the evolution of this new tool has taken place over a very short period of time.

The current microcomputer revolution really didn't begin until 1981 with the introduction of the IBM Personal Computer. Actually, the microcomputer industry is quite young as it was in 1977 when the first affordable microcomputer was offered for sale by Apple. This offering to the public of desk-top computers marked a new era for the entire computer industry. Prior to this period desk-top computing was an expensive dream. The current variety of hardware devices and components that are available on the market today are the result of an extremely competitive and evolving industry. The microcomputer retail market is actually less than ten years old. The basis for the rapid changes that it has experienced is an exponential decline in the costs involved with the manufacturing of the small logic and storage chips, in conjunction with massive increases in memory capabilities. New technology in the microcomputer industry has paved the way for the inexpensive development of state of the art computing power and has made it readily available to the average consumer. An example of how the industry has lowered the prices and at the same time expanded the

capabilities of the microcomputer can be found in the Zenith 248 Computer system. This system has 512,000 bytes of internal storage available to its central processing unit and the system sells for less than three thousand dollars. When Radio Shack offered its state of the art Color Computer in 1982, with 4,000 bytes of storage for the central processor, it cost less than three hundred dollars. The ratio of internal storage to dollars for the Color Computer is 13 to 1, but the same ratio for the Zenith 248 is approximately 170 to 1.

The microcomputer industry is still in a developmental process, changing on a daily basis. The many changes brought forth by the rapidly evolving hardware also directly influence the programs and applications that are processed on microcomputers.

2. Software

There are many types of software(computer programs that make the computer work) available for the microcomputer. One determining factor about which software to use is the type of operating system that the microcomputer employs. The operating system is a computer program that acts as a top level manager for the computer, without this program it would be very difficult to control the cpu and have it perform requested functions. CP/M is a popular operating system for 8 bit processors and MS/DOS is one of the most popular for the 16 bit processor. The Zenith computer systems have operated with the CP/M operating system and with a Zenith version of the 16 bit operating system called Z-DOS. There are some programs that will run on 8 bit systems, but not on 16 bit operating systems. This can be confusing for the novice as well as the expert.

There are many types of computer software available today. There is software that will perform the functions of an electric typewriter (word processing software), software that performs the duties of an accountant (spread sheets) and, software that can classify and catalog unending amounts of material (data base management software). In addition, there are a variety of compilers that allow one to write their own applications for microcomputers. The list goes on, but we will take a closer look at those classifications of software whose application is most prominent in our area of study.

a. Word Processors

Word processors have taken some of the difficulty out of being a secretary. Now almost anybody can produce quality reports and typewritten letters with the flick of a key. These handy programs were introduced in the early 1980's and are now the

most popular activity on microcomputers. [Ref. 9] There have been many new and innovative ideas added to the simple word processors that first entered the market. Now one can have their spelling checked as a letter is being composed, if a word is spelled wrong the system will even suggest a correct spelling. The advent of this type of software has enabled the immediate editing and re-writing of long and often complicated documents and reports. The idea of having to reformat, or make deletions and additions to typewritten papers was an administrative burden, but the word processing capablities of today have streamlined these tiresome tasks. Word processing software is also used to facilitate the interface between data base management systems and the user. Additionally, the text editing capabilities of the software are often used to create new programs and applications for the microcomputer.

b. Spreadsheets

Spreadsheets have helped to make budgeting, financial analysis, and forecasting everyday actions for the line manager. The manager who employs this type of tool has become less afraid of the world of finance. The use of spreadsheets can lead to increased productivity and innovative managerial decisions. Through the use of "what if calculations" the manager of an organization can simulate and often forecast the future ramifications of his/her various decision alternatives. These calculations are done rapidly and accurately, providing processed information back to the decision maker. Therefore, the decision process can be improved, with decisions being made in a matter of hours instead of days or weeks. The spreadsheet could be considered as the driving reason that the business world has so firmly embraced the microcomputer. [Ref. 10] It allows for the quick manipulation of many rows and columns of extremely large numbers. These rows and columns can also be expanded and contracted as the situation dictates. Most spreadsheet software is capable of providing printed copies of all work sheets and finished applications, giving the user a hardcopy of the performed calculations. The majority of the software available is capable of storing working data and recalling it at another time. This gives the user the flexibility to quit working on a long or complex problem without losing any progress that had been attained toward a solution. There is also an ability to integrate the spreadsheet processing with other software applications such as word processors, allowing the user to attach memos or comments to his/her work sheets. The concept of the spreadsheet has broad applicability and offers microcomputer users a powerful tool.

c. *Data Base Management Systems*

Data Base Management Systems are the third most popular type of software when compared to word processors and spreadsheets. They serve as the communication tool between the user of the microcomputer and the data that the user has stored. The current operating systems for the microcomputers on the market today do a poor job of data management, therefore data base management systems have been developed to assist the user in accomplishing this often confusing and time consuming task. A data base management system (DBMS) can facilitate the retrieval and storage of organizational information. [Ref. 11] A DBMS can manipulate many different types of records, work with several different files at the same time, and join them if necessary to provide the desired output, do numerical calculations, and perform a host of other functions that may be valuable to users of the system. These capabilities mean that it is no longer necessary to conduct sequential searches and construct entirely new files when special applications or needs are identified. DBMS's are now being recognized as essential microcomputer tools that can provide user friendly ways of accessing data through the use of system query capabilities. Additionally, the employment of these data management systems allows for multiple users of the same data files helping to eliminate the storage of duplicate data. These systems are rapidly becoming more popular as their potential applications are realized.

F. SUMMARY

The Third Marine Aircraft Wing is a dynamic organization operating a variety of modern sophisticated military aircraft in support of our national defense. An effective system of aviation logistic support is necessary to meet the operational readiness goals established to meet mission requirements. Advances in both hardware and software technology have provided the Marines with an important tool in managing their aviation assets. If they are properly implemented and used, microcomputers have tremendous potential to improve the efficiency and effectiveness of aircraft maintenance and material support.

II. THE CASE AT THIRD MARINE AIRCRAFT WING

This chapter is the statement of the case regarding the implementation and use of microcomputers for aviation logistic support functions in the 3rd MAW. We begin by describing the current Wing Information System Management Office organization and continue with background concerning the introduction of Zenith microcomputers into the aircraft support arena. We then describe the situation in the ALD and each of the aircraft groups at the time of our study. In the discussion we look at each individual organization and review its system development efforts, personnel and training concerns, and preventative maintenance and utilization issues.

A. ORGANIZATION FOR INFORMATION SYSTEMS MANAGEMENT

The Fleet Marine Force and its supporting establishment require automated information systems to support the command and control functions for mission accomplishment. In the 3rd MAW the Wing Information Systems Management Office (WISMO) assumes these responsibilities. When we conducted our research the structure of the 3rd MAW detailed the WISMO with a special staff function, and the officer in charge reported to the Commanding General via the Chief of Staff. The WISMO advised the commander and his staff and acted as the command's single point of contact for ADP matters. In this capacity the office served as the focal point with other Marine Corps and other service authorities on all ADP matters pertaining to coordination of requirements, objectives, concepts, plans, and policies for multiple automated information systems. The office exercised staff supervision of organic data processing units and equipment, and coordinated the preparation of command standing operating procedures, support plans, and contingency plans. In addition, they were responsible for coordination of ADP training for all command personnel and for providing ADPE-FMF programming support.

At the time of our study, as had been the case in the past, the WISMO did not play a significant role with regard to the Shipboard Uniform Automated Data Processing System (SUADPS) and the evolving Naval Aviation Logistics Command Management Information System (NALCOMIS), the major systems used in aviation logistics support. Support for these systems is provided by the cognizant Naval

activity in direct liaison with the appropriate units within the aviation logistics support structure of the wing. The introduction of the microcomputer into the aviation logistics support arena more closely involved the WISMO with aircraft maintenance and material support since the WISMO was concerned with microcomputer procurement distribution and support.

The addition of microcomputers as management tools for aviation logistics functions nearly doubled the amount of automated equipment that the WISMO tracked and supported. The range of assets included over 350 processors of various types. Among them were ADPE-FMF, a rugged version of the IBM series 1 known as the "green machine"; the IBM Displaywriter, a dedicated word processing system with limited data processing capability; the XEROX 860, and the LEXITRON dedicated word processing systems; and the Zenith 120 and 150 microcomputers. The Wing would begin receiving the Zenith 248 microcomputer system when they were delivered to the supply system.

When we conducted our research, the WISMO had an officer in charge with a non commissioned officer in charge to assist him. In addition, there were two branches within the WISMO structure - the operations branch with one officer and four enlisted and a research and development branch consisting of one officer. Figure 2.1 details the structure and responsibilities. The changing nature of technology and the large scale introduction of office automation placed increasing demands on the WISMO. The Commanding General's Staff saw a need to restructure it; Figure 2.2 represents the desired structure which had not yet been approved by Headquarters Marine Corps nor implemented by the 3rd MAW at the conclusion of our study.

As the focal point for the management of automated information systems within 3rd MAW, the WISMO published Wing Order 5230.3B in May 1982. This order outlined the organization for information systems management within the Commanding General's Staff sections and subordinate levels of command in the Wing. The primary emphasis in the order was on the ADPE-FMF (the "green machine"), but the basic responsibilities and procedures for information systems management still applied with regard to the then current inventory of microprocessors which included the Zenith microcomputer systems. The order called for the appointment of an Information Systems Coordinator (ISC) for all general and special staff sections that had cognizance over specific ADP systems. It was the ISC's responsibility to assist the users within his unit and also to assist the WISMO. The ISC had to be a technical

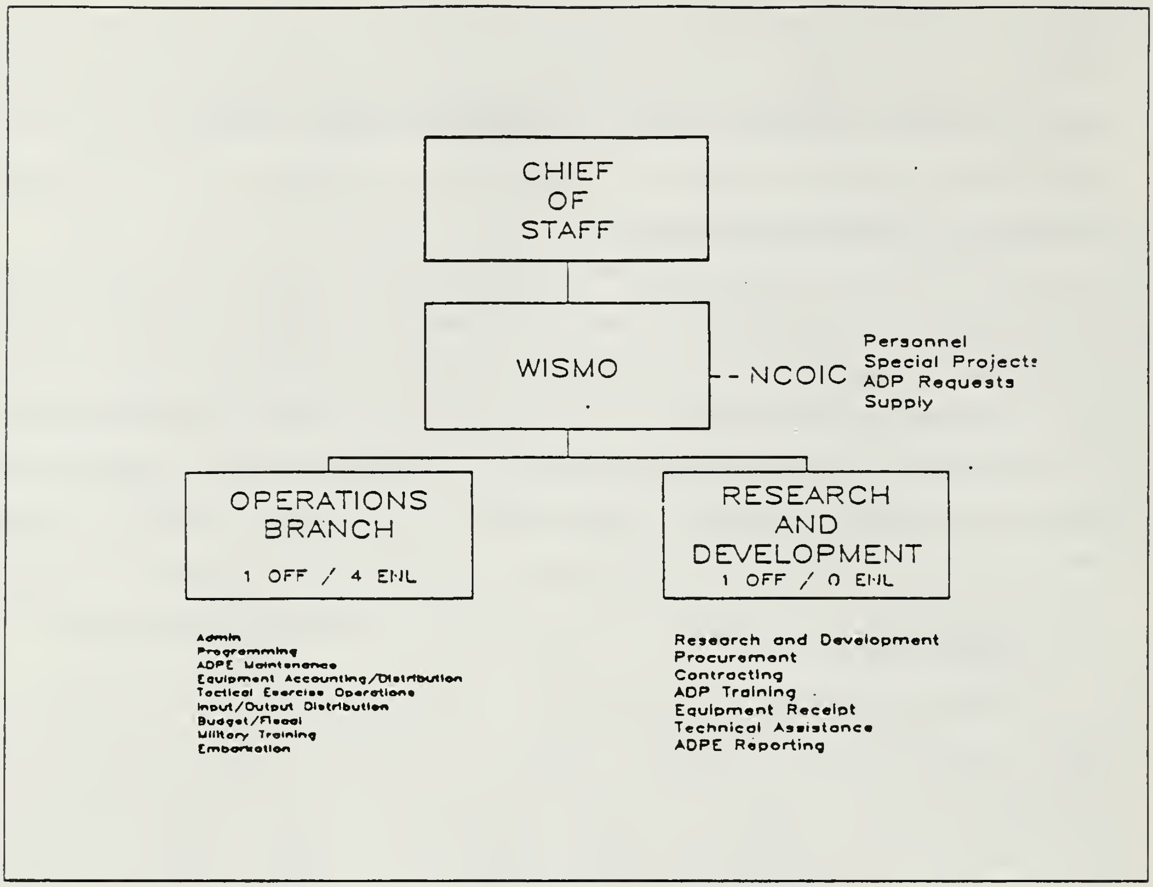


Figure 2.1 Present WISMO Structure.

expert in the area supported by the automated system, and as such was expected to review and approve requirements with regard to feasibility, desirability, priority, and completeness of documentation. The order directed the ISC to concentrate on what had to be done rather than how it should have been done. It further stated that each group and squadron would assign an information systems coordinator whose role it was to serve as the principal point of contact regarding all data processing matters - to include hardware and software problems. In all cases the appointment of an ISC required a written appointing order, copies of which were maintained by the WISMO and the group ISCs as appropriate. This structure and its general guidelines provided the basis for effective management of information resources within the Wing.

The previous discussion provides a basic description of the controlling structure for information systems management in the 3rd MAW at the time our research was conducted. Given this framework, we look at the introduction of microcomputers into

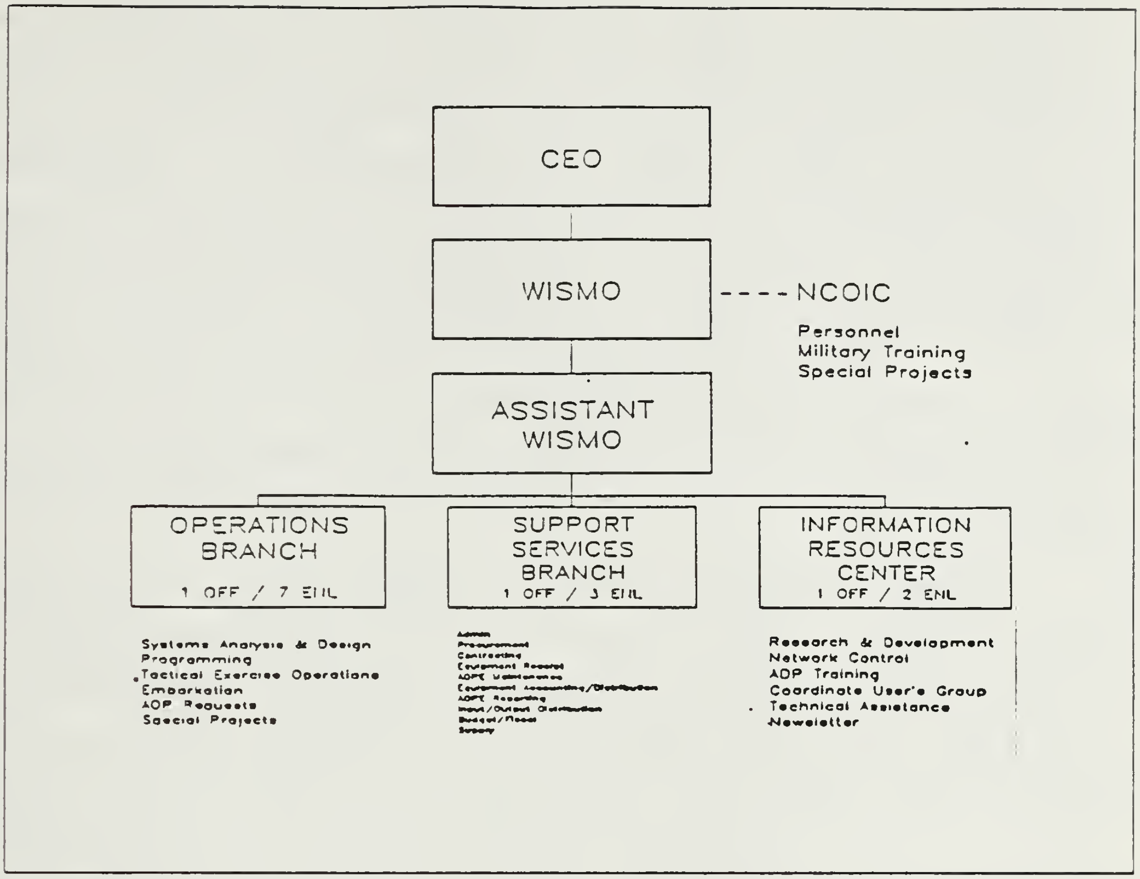


Figure 2.2 Requested WISMO Structure.

the aviation logistics support arena and review the specific details of their management and application in the various staff sections and subordinate commands within the overall wing organization.

In August 1984 a decision was made by Commander Naval Air Forces Pacific (COMNAVAIRPAC) to pursue a plan for implementation of Zenith-120 microcomputers within NAVAIRPAC activities. [Ref. 12] NAVAIR 0035T-37-4, which is the Table of Basic Allowances for Marine Aviation units, established allowances for word processing equipment based upon an allowance change request submitted by MAG-14, Second Marine Aircraft Wing in February of 1982. The justification specified a list of functions within the aviation supply and maintenance arenas all of which were basically considered as word processing applications. [Ref. 13] COMNAVAIRPAC provided funding to the Commanding General, Fleet Marine Force Pacific (CG FMFPAC) to purchase the necessary system components. In

compliance with this plan, CG FMFPAC directed the First Marine Brigade / MAG-24 in Hawaii to prepare a contract for the purchase of 88 Zenith-120 microcomputers to be distributed to all FMFPAC units. Each unit was to consist of the following components: the basic system as specified in the existing Air Force / Navy contract NR F19630-83-D-0005, 256 kilobyte memory expansion board, a dot matrix printer, the Disc Operating System (MS-DOS or Z-DOS), and a Basic interpreter and compiler. Total cost was $2996.00 per system. The primary purpose of the equipment was for use by the maintenance departments of the flying squadrons and the Headquarters and Maintenance Squadron, and the MAG supply department. [Ref. 12] A subsequent decision, made shortly after the initial system components were specified, modified the purchase requirements to include only the basic microcomputer system, a dot matrix printer and Peachtext word processing software. Total cost was $2672.00 per system. [Ref. 14]

A number of issues began to surface as the Zenith computer systems arrived on the user's doorstep. During December 1984, the 3rd MAW identified a problem to FMFPAC concerning the operating system and word processing software called for in the modified purchase requirements. The CP/M 85 operating system (standard with the basic Z-120 system) supported the 8 bit PEACHTEXT word processing software but did not support the 16 bit word processing software which was received with the equipment. This incompatibility had to be resolved before the microcomputers could be put to effective use. 3rd MAW proposed that they purchase the Z-DOS operating system to allow them to keep the 16 bit word processing system and also give them the capability to use a wider selection of software available for the 16 bit processors. [Ref. 15] The recommendation was approved and the Z-DOS operating system was procured.

The acquisition of the Zenith PCs greatly increased the visibility and concern with regard to the proper utilization of systems funded by Operation and Maintenance, Navy (O&M,N) funds. The computers were purchased with Navy funds to support those sections of a group or squadron directly involved in aviation logistic support. As a result, direction was promulgated calling for specific distribution of allowance assets. Each H&MS was to receive five microcomputers with a proposed distribution of three to supply and two to maintenance. Each flying squadron was to receive one for primary support of the aircraft maintenance department and secondary utilization in support of S-3, flight operations. Use of the systems for general administrative and

logistical functions was not authorized, and a message originating from CG Third MAW cautioned users regarding the improper employment of material provided for direct support of aviation only. CG FMFPAC guidance further directed that accountability of the Zenith Data systems would be under the normal custodial procedures outlined in the USMC Aviation Supply Desk Top Procedures, and that the systems would be remain-in-place items not to be deployed with rotational squadrons. They also indicated that the Zenith-120 system was not Tempest certified, and, therefore could not be used to process classified material. [Ref. 13]

In May 1985, the Aviation Logistics Management Section (now Aviation Logistics Department - ALD) in conjunction with the WISMO, sponsored the first Zenith-120 users conference with the intent of providing 3rd MAW maintenance and supply activities with guidance for Z-120 usage and also to provide status on system development. Proposals resulting from the conference addressed software standardization and compatibility issues. The wing aviation maintenance and supply sections elected to share joint responsibility for software development, system distribution and training, and funding coordination. Accordingly, it was determined that all future requests for additional hardware or software would be forwarded through the ALM section for review and further processing.

The guidelines resulting from the meeting established a basic framework on which to build. The first attempt at standardization of software called for all units to utilize the Z-DOS 16 bit operating system and the 16 bit Basic compiler. The Wing also initiated procurement of Wordstar Professional and DBASE II to be made available to end users early in the fourth quarter of fiscal year 1985.

In addressing the training issue , the Wing noted that training was available for Zenith users at NAS North Island, but that this training and any use of local contractors for training would be funded through the respective activity's TAD budget. The Wing would keep activities abreast of any training available at no cost.

At the time of the conference there was no contractual arrangement for maintenance of the microsystems, but establishment of one was in planning, and the issue of repair versus replacement was discussed. The ALM section was also concerned with systems development and encouraged all users to examine the potential of the Z-120. From their limited resources, the ALM offered what assistance was available in terms of software development and programming and directed all activities to forward any locally designed programs to the ALM system analysts for approval and possible dissemination throughout the Wing. [Ref. 16]

Those who were involved in setting up this microcomputer conference proposed to use it and future forums like it as a means of developing the potential of automation for aircraft maintenance and material support. No schedule was established, and at the conclusion of our study, there had been no further action in this regard. An interview with one of the participants indicated that only two of the original committee members established as points of contact were still at the Wing, and that the previous importance placed on these issues within the aviation logistic support arena had been overshadowed by heavy operational commitments, the introduction of new aircraft into the inventory and ongoing plans to restructure the organization.

When we finished our research, it had been nearly two years since the first microcomputers appeared on the loading docks of 3rd MAW activities, and microcomputer use for aviation logistic support was continuing to expand throughout the Wing. The remainder of the case addresses the structure of the organization at all levels of command and the extent to which each was using microcomputers as a tool for aircraft maintenance and material support. The structure for logistic support in Marine Aviation is dictated by guidelines which define the organization and its functions and provide a standard throughout the Corps. The introduction of microcomputers into the aviation logistics support arena had a different impact on each of these "standard" organizations. Although each Marine Aircraft Group (MAG) operates on the basis of an established norm, each is unique, not because it flys a different aircraft, but, mainly, as a result of the management and leadership style of the people in charge. Since each MAG is unique, and because the ALD is singular in its position within the 3rd MAW, we address each of them as a separate subsystem of the overall system in the presentation of the case. Each presentation is organized in four sections. The first section addresses the organization for informations systems management within the unit; the second section looks at the systems development effort that had taken place; the third section reviews personnel and training issues; and the fourth section discusses preventative maintenance and utilization within the unit. There were many similarities in the implementation and use of microcomputers across the Wing, and these are noted in each instance; however, in some cases there were profound differences.

B. MICROCOMPUTER USE ACROSS THE ORGANIZATION

1. 3rd MAW - Aviation Logistics Department (ALD)

a. Organization

As an integral part of the Commanding General's staff, the Aviation Logistics Department is located within the wing headquarters at MCAS El Toro. At the time of our study, they used a total of six Zenith microcomputer systems in support of aviation logistics functions - three in the maintenance area, two in avionics, and one in supply. A Chief Warrant Officer served as the ISC for the ALD. This was a collateral duty which encompassed the use of Zenith systems in the department. Although this responsibility complemented his primary duty, the major thrust of his efforts were directed at his job of monitoring the major systems being implemented or readied for implementation for use in aviation logistics support - i.e., SUADPS-RT [3] and NALCOMIS. This officer was an aviation supply officer, but had previous experience as a COBOL programmer in the Marine Corps. He was one of the two remaining committee members in ALD designated as a point of contact during the one and only ALM Zenith users conference.

b. Systems Development

Although the Wing ALD reviewed and forwarded any requests for additional microsystems in support of aviation logistics, there was no formal analysis conducted to determine the actual necessity for automated systems. There were no specific wing orders or instructions that addressed the acquisition, implementation, and use of microcomputer systems for aviation logistic support applications, although the previously mentioned Wing Order 5230.3B and available correspondence and message traffic addressed these issues to a limited extent.

Concerning the software component of the overall computer system, there was no process for review and standardization of software applications across the Wing. There had been a somewhat limited attempt to do so, but the level of involvement was rather low when considering the number of self-developed programs being used in all the groups. One of the standard application programs being used wing wide was the Support Equipment Standardization System (SESS). This Navy wide program, developed under the direction of the Aircraft Intermediate Maintenance Support Office (AIMSO) in Patuxent River, Maryland, was written in COBOL and was

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[3] SUADPS-RT or Shipboard Uniform Automated Data Processing System-Real Time is the latest software for use in inventory management of aviation supply material. This software is used on the Honeywell Minicomputer.

available for use on Monroe, Zenith, IBM, and WANG microcomputers. SESS, which was designed for use in the management of support equipment, had been accepted by all Type Commanders and was in operation at 64 sites at the time of our study. In addition to this package, one of the maintenance analysts at the wing, who had a personal interest in computing, had written a number of application programs in the BASIC language for functions in the maintenance area. These programs had been made available for general use to aid specific maintenance functions but had not been established as a work standard.

Data gathered from the questionnaires distributed within the ALD revealed that the department was using the following software for various applications: WORDSTAR, DBASE II, DBASE III, LOTUS 1-2-3, PEACHTEXT, TURBO PASCAL, and SUPERCALC 3 along with various utilities and three different spell checkers. Each of the functional areas within the department had developed programs for its own use. These applications were written by computer knowledgeable individuals within each section using software familiar to them.

c. Personnel and Training

The questionnaires and subsequent interviews indicated that the rank of those using the microcomputer systems ranged from Lance Corporal to Captain. The MOSs were consistent with the manning requirements established for those sections.

All of the survey responses indicated the majority of training was conducted on the job through the use of vendor tutorials and self-teaching. There were a few individuals with outside education or a personal interest in computing that also provided support in this area. Training was available at NARDAC San Diego and also through outside contracts in the local area but was not extensively utilized due to time and funding constraints. In June 1986 an Information Resource Center (IRC) was established at MCAS El Toro by the WISMO working in conjunction with the Regional Automated Services Center (RASC) on the base. The reason for this initiative was to provide training support for microcomputer users through a continuing series of training classes. The classes offered included Introduction to Microcomputers, Microcomputer Management, DBASE II, WORDSTAR, and SUPERCALC3. Additional topics would be developed as the need arose. The classes were scheduled for a two to three hour period each Monday through Friday. The ALD had taken advantage of this opportunity and sent some of its troops through the various course offerings.

d. Preventative Maintenance and Utilization

Research indicated that there was no consistent standard for preventative maintenance (PM) on the Zenith systems in the ALD. Half of the sections indicated that they performed some type of PM; the other half said that they did no PM on their equipment. All repair problems for the systems were resolved under a maintenance contract.

Usage of the Zenith systems varied in the different functional areas of the department. In half the sections use was heavier at the end of the month. In the others, use was fairly consistent. On the average, each microcomputer was used four to six hours each day with one section indicating a high of seven hours per day. Output from these systems was used both for internal shop management and for dissemination of information up and down the chain of command.

2. Marine Aircraft Group 11

a. Organization

Marine Aircraft Group 11, located at MCAS El Toro, was the first MAG to transition from the F-4 Phantom II to the new F/A-18 Hornet. In addition to operating the Hornet, MAG 11 also flys the RF-4B Phantom II photo reconnaissance aircraft. In the next two years as MAG 13 turns in its A-4 Skyhawks for the new AV-8B Harrier and moves its flag to MCAS Yuma, MAG 11 will pick up the A-6 Intruder and KC-130 Hercules squadrons which are now a part of MAG 13. Additionally MAG 11 will stand up a new F/A-18 Fleet Replacement Squadron (FRS) for training of FA-18 pilots. The changes which are taking place in this organization, coupled with the heavy operational commitments dictated by the group's mission, generate a high level of activity and place considerable demands on the Marines in this unit.

The Group ISC in MAG 11 was an F/A-18 pilot whose primary duty was Group Adjutant. Although this Captain had a BA in a computer related field, his assignment to the position of ISC was not based on any specific criteria. For instance, he had no formal training for this function. The job of ISC in MAG 11 was just one of the collateral duties assigned to the Adjutant. In fact, this officer was leaving the group soon, and his replacement as Adjutant was to assume the ISC responsibilities. The job of Group Adjutant placed a considerable demand on this officer's time; however, he indicated that he managed to spend five to ten hours per week on microcomputer related issues. He contended that this was not sufficient time to do an

adequate job. The majority of his effort in this regard was directed at procurement and maintenance issues, and most of his contact with the individual squadron shops that use micros were based on these concerns. This officer reviewed all requests for additional systems and forwarded them through the appropriate channels for approval. He stated that there was a definite command interest in the potential of microcomputer systems to support the group's mission. In his capacity as ISC he did not hold any group orders or instructions, either written or in process, pertaining to microcomputer systems.

Headquarters and Maintenance Squadron (H&MS) employed ten Zenith microcomputers in aviation logistics support functions. Eight of these systems were used in maintenance related functions; the other two were located in supply. The systems used in the maintenance arena were located in Maintenance Administration, Production Control, Avionics, Power Plants, Ground Support Equipment, Ordnance, Analysis, and Quality Assurance. An additional eight systems to be used for maintenance applications were placed on order during June based on approval from the Wing allowing MAG 11 to establish a prototype for a Logistics Control Center (LCC). This initiative was proposed by the Group Aircraft Maintenance Management Officer.

Each of the flying squadrons in the group used a Zenith microcomputer in their Maintenance Administration section. Two of the squadrons had a second system in Quality Assurance, and the others had an additional unit on order.

b. Systems Development

The researchers had an extensive discussion with the group AMMO concerning the implementation and use of microcomputers in the maintenance arena. His enthusiasm was obvious when looking at the course he had set for the group in this regard. This officer had been with the F/A-18 program for several years. In his previous tour of duty he served as the head of the Resident Integrated Logistics Support Detachment (RILSD) at McDonnell Aircraft Company (MCAIR) in St Louis. In this capacity he was exposed to innovations in management theory and automation technology as they exist in the defense industry. This experience gave impetus to his initiative to establish a Logistics Control Center in MAG 11. The use of microcomputers was one of the key elements in this project.

When the first Zenith microcomputers were received in mid-1985 there was little direction applied to their implementation and use. Individual shops within

H&MS and the flying squadrons developed application programs to fit their own needs using software that was available and understood by the Marines in each unit. The Group AMMO recognized the potential of these microprocessors and the benefits to be achieved in automating many of the routine maintenance functions. Consequently, he initiated a microcomputer implementation project and tasked one of his officers with the collateral duty of developing a prototype proposal for a group wide system. The goal of this computerization plan was set forth as follows:

> To develop a system for the integrated and coordinated utilization of the computer as an aid in the collection, processing, and manipulation of information required to efficiently support MAG 11's aircraft maintenance effort.

Key issues addressed in the resultant plan included computer system development personnel, computer system requirements, and a plan of action. The specific details outlined in the Preliminary MAG 11 Computerization Plan were pertinent to the overall study; therefore, it is included as Appendix B.

The AMMO emphasized the following points in the implementation of this program. MAG 11 was committed to the maximum utilization of available computer assets; however, the group aviation logistic support elements were to proceed in their efforts with a sound understanding of their basic limitations. The first priority was mission accomplishment, and the tempo of operations required maximum attention; system development could not degrade required levels of support. Additionally, their knowledge of computer system development was limited. The process would be a learning experience for everyone; therefore, all were encouraged to participate to create a system that would provide maximum effectiveness and efficiency. He emphasized that this would be a slow, arduous process; however, dedication to the program goals would eventually result in "a system which will be all encompassing, integrated, and timesaving."

MAG 11 was able to tap another resource with regard to its computer implementation project. While we were there, we interviewed a Naval Reserve officer attached to a unit which does projects for the Naval Air Rework Facility (NARF) at NAS North Island under the sponsorship of the Naval Air Systems Command (NAVAIRSYSCOM). At the time, he was performing his annual two weeks of active duty. As a civilian, he was a computer engineer by profession; during the past several years he had done work in various facets of the computer industry. He was able to

offer considerable development assistance and did an extensive amount of work on the group's draft of a Zenith Microcomputer Users Manual. He lived in the vicinity of El Toro and would be able to continue an association with the group as a part of his normal Naval Reserve duties each month.

In discussions with the supply officer the researchers learned that the two Zenith microcomputers being used in the Group Aviation Supply Support Center (GASSC) were employed by the Supply Accounting and Squadron Support Sections. Application programs were developed by MAG 11 supply personnel.

Data gathered from the individual questionnaires and confirmed in follow on interviews indicated that the individual squadrons were using WORDSTAR, DBASE II, LOTUS 1-2-3, and PEACHTEXT software. Not all of those responding had access to each of these packages. This software was obtained as a part of the initial issue or during subsequent procurement action. WORDSTAR was the software of choice in terms of word processing applications, although one of the respondents indicated limited use of PEACHTEXT. LOTUS 1-2-3 and DBASE II applications were consistent across the group. DBASE II was the standard software being used in the development of the overall computer system. A key element in the philosophy of their system development was the creation of a user friendly system. The group felt that this could be accomplished on available hardware by writing all possible applications in DBASE II using a menu driven approach to call modules and tasks. Specific applications are cited in Appendix B.

c. *Personnel and Training*

The survey and subsequent interviews indicated that the rank of those using the microcomputer systems ranged from Lance Corporal to Captain. The MOSs were consistent with the manning requirements established for each specific section.

The majority of the training for the Zenith microcomputers was conducted on the job through the use of vendor tutorials or self-teaching. Early on, the group did take advantage of some of the training offered by the Regional Automated Service Center (RASC), Camp Pendleton and local college and university classes. A number of the shop supervisors were sent to these sessions. The AMMO placed a considerable emphasis on using available talent and relied on those individuals with a personal interest in computing to also assist in the training effort.

d. *Preventative Maintenance and Utilization*

The topic of preventative maintenance (PM) was one area in which we found no consistent group policy. Some shops indicated that they performed PM on a routine basis, but the extent of the PM varied among those shops. Other sections did not do any PM at all. This issue was not addressed in the draft of the group's Zenith Microcomputer User's Manual.

The survey of computer usage revealed a high level of involvement with the Zenith systems. On the average the microcomputers in each shop were used about ten hours a day, and, in those shops that were manned around the clock, usage in excess of 15 hours a day was indicated. The majority of respondents said that usage was fairly consistent throughout the month, but some shops indicated heavier usage when required reports were due. No specific time of the month was prevalent.

3. Marine Aircraft Group 13

a. *Organization*

Marine Aircraft Group 13 supports attack aircraft - the A6E Intruder and the A-4M/OA-4M Skyhawk. In addition they support the KC-130F and R Hercules aerial refueler. As previously indicated the group is in the planning stages of moving the command from MCAS El Toro to MCAS Yuma, Arizona and transitioning its A-4 squadrons to the AV-8B Harrier. The A-6 and KC-130 Squadrons will become a part of MAG 11. These transitions necessitate a considerable amount of additional activity within the group besides the continued operational commitments dictated by its mission within the context of national defense.

The job of ISC in MAG-13 was a collateral duty held by a Second Lieutenant whose primary MOS was aviation supply. Assignment to this position was not based on any specific criteria. The officer had no formal schooling, although he did take some computer classes in college related to a degree in public administration, and at the time of our study was working on a masters degree dealing with computer management. His primary job as Assistant Repairables Material Section (RMS) Officer required a considerable amount of attention because of the large inventory of repairable aircraft components that the group maintains. He generally spent 3 to 4 hours per week on his collateral duty as ISC and had no dedicated clerical support for this responsibility. In interviews conducted with the officer he indicated that he was able to adequately handle issues pertinent to information systems management within the group. This officer stated that he had minimal interaction with the group or

squadron Commanding Officers in his capacity as ISC, instead he dealt almost exclusively with the work sections who utilized microcomputers within their respective shops. He indicated that he did have specific points of contact in each squadron and shop that utilized the Zenith systems. Any requests for additional systems were reviewed by him and forwarded through the group fiscal section before being sent through the normal approval channel. There was no formal review process within the group to determine the actual necessity for automated systems. There were no group orders or instructions, either written of in process, regarding the acquisition, implementation and use of microcomputer systems.

The Headquarters and Maintenance Squadron (H&MS) used seven microcomputers within the aviation logistics support elements of the group. Five of these systems were used for maintenance functions, one was used in supply, and one was used at a support detachment at MCAS Yuma. In the maintenance arena the systems were employed in Ordnance, Ground Support Equipment, Production Control, Avionics, and Quality Assurance. Requests for three additional computers to be used in maintenance applications had been approved and forwarded for action. These assets would provide a second system for Avionics, and new systems for Airframes, and Power Plants.

Each of the seven aircraft squadrons had microcomputers being used in their Maintenance Administration section. Additionally, two of the squadrons had a second computer being used in Quality Assurance.

b. System Development

Discussion with the group Aviation Maintenance Management Officer indicated that there was no coordinated effort to develop and share programs within the group. Although the squadrons may have shared programs written by someone within the group or may have made use of the few programs offered by the Wing, there were no standards for everyone with the exception of the SESS program discussed earlier. It was more or less up to the individual units to develop their own applications - to use whatever worked best for them.

The Supply Officer indicated that the one microcomputer being used within the Group Aviation Supply Support Center (GASSC) was used in the accounting section and that the programs used were developed in-house. A request for an additional system to be used in the Squadron Support Section had been approved and forwarded for action.

Data gathered from the individual questionnaires and confirmed during subsequent interviews indicated that the following software was used by the various work sections: WORDSTAR, DBASE II, LOTUS 1-2-3, and PEACHTEXT; however, each section or shop did not necessarily have all of them. These software packages were either obtained as part of the original system issue or through follow on procurement action. Some shops also indicated that they did use software obtained through other channels. Answers relating to application questions revealed a variety of uses for each of the available software packages. A look at what some shops were doing provides a basis for comparison. The Ordnance section indicated that they used WORDSTAR for all of their applications. The Avionics section used LOTUS 1-2-3 for some of their jobs such as rosters, personnel reports, and training data; DBASE II for inventory and data storage; and both WORDSTAR and PEACHTEXT for documents and correspondence. Production Control used LOTUS 1-2-3 for various production reports and scheduling and WORDSTAR for various rosters, personnel reports, and miscellaneous requirements. The flying squadrons which answered the survey indicated that they primarily used WORDSTAR and PEACHTEXT for rosters, reports and other applications and DBASE II to maintain various lists.

c. *Personnel and Training*

The questionnaire and follow-on interviews indicated that the rank of those using the microcomputer systems ranged from Lance Corporal through Master Sergeant. The MOSs were consistent with the manning requirements established for those sections.

For the most part the training for current operators was done on the job through the use of vendor tutorials and self teaching, although a few units did request commercial training for some individuals early on. The ISC indicated that the Information Resource Center at El Toro would provide further opportunity for training if the individual units were to take advantage of it; each squadron was responsible for its own training.

d. *Preventative Maintenance and Utilization*

The questionnaire indicated that there was no consistent policy regarding preventative maintenance(PM) and the Information Systems Coordinator indicated that he was unfamiliar with any such requirement or any applicable material support. All repair problems were resolved under a maintenance contract and each unit took care of its own problems in that regard.

Usage of the microcomputer systems in the group varied among the work sections and also according to the time of the month. The majority of the respondents to the questionnaire indicated that they used their system in excess of 6 hours per day with 12 hours per day being the median. Usage was particularly heavy at those times of the month when required reports were due and that was primarily determined by established deadlines, although most indicated that the end of the month was busiest. Output, for the most part, was used for internal shop management, but about half of the respondents indicated that they did provide information to group staff officers and the group commander, and even fewer indicated that output was passed to the wing level.

4. Marine Aircraft Group 16

a. Organization

Marine Aircraft Group 16 is a helicopter group that operates from MCAS(H) Tustin about five miles north west of MCAS El Toro. They fly the CH-46E Sea Knight medium helicopter and the CH-53A and D Sea Stallion heavy helicopter. Some squadrons have transitioned to the new CH-53E. MAG 16 is presently the largest aircraft group in the Third MAW.

The job of ISC in this group was a collateral duty held by a First Lieutenant whose primary MOS was logistics. Her assignment as the ISC was not based on any specific criteria. This officer had no formal schooling for her ISC responsibilities; however, she was scheduled to attend the two week Automated Data Processing Orientation Course given at the Marine Corps Development and Education Command in Quantico, Virginia. She had an undergraduate degree in personnel management, but was nearing completion of a graduate degree in computer resources management. This officer's primary duty as Maintenance Management Officer for the group demanded the majority of her efforts, but she also managed to spend a good deal of time on her ISC responsibilities - about two days per week.

In discussions with this officer she indicated that she was not able to do the job as well as she would like because of a lack of time and clerical assistance. She had no dedicated clerical support for this function, but felt that she could employ someone full time in this capacity. The ISC stated that she had considerable interaction with the group Commanding Officer who was very computer oriented and had an open door policy in this regard. In addition she worked very closely with the squadron ISCs and any of their specific sections that required her assistance. This officer reviewed all

requests for additional systems, and, although there was no formal review process within the group to determine the necessity of automating a particular function, she indicated that she did do some investigation of the economic analysis that were submitted. Her immediate superior, the S-4 Officer, was actively involved in the review process before the requests were forwarded through the normal approval channel. There were no group orders or instructions as such which pertained to microcomputer use; however, the ISC developed turnover folders and distributed them to each squadron; they contained pertinent message traffic, local user group bulletins, sample economic analyses, and other relevant information.

The Headquarters and Maintenance Squadron(H&MS) employed five microcomputers in the aviation logistic support functions. Three were used in maintenance areas; two were used by supply. Maintenance employed these systems in Maintenance Administration, Production Control, and Ground Support Equipment. There were additional systems on order for which delivery was anticipated. These systems were to be used in Avionics, Power Plants, Ordnance and IMRL (Individual Material Readiness List). [4]

Each of the flying squadrons had a microcomputer being used in their Maintenance Administration section, and in one squadron the survey indicated that the system was located in the Quality Assurance section.

b. System Development

We discussed the implementation and use of the microcomputer in the maintenance arena with the group Assistant Aviation Maintenance Management Officer, and he indicated that the introduction of microcomputers had a positive impact on the way that all the squadrons did business. He further stated that there was no coordinated effort to develop and disseminate a standard package of maintenance application programs within the group. Some of the squadrons, however, may have shared similar programs which were developed in house or provided by the Wing ALD, and the group was using the standard SESS program for management of its support equipment.

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[4]The IMRL identifies material requirements and provides a basis for procurement of support equipment. This information is used for decisions concerning overall readiness posture, budget forecasts, equipment procurement, and redistribution of assets.

The Group Supply Officer indicated that the two microcomputers being used within the supply department were located in the Accounting Section and the Squadron Support Section. Programs for these systems were developed by group supply personnel to meet their own requirements.

Data gathered from the individual questionnaires and confirmed during subsequent interviews indicated that the following software was in use by the various sections: WORDSTAR, DBASE II, DBASEIII, DBASEIII+, LOTUS 1-2-3. and PEACHTEXT; however, each shop did not necessarily have all of this software available. These packages were either obtained as part of the original system issue or during follow-on procurement action. In some cases, the shops used software obtained through other channels outside the supply system. The response to application questions revealed a wide range of use for the various software packages, and, in many cases, different software was used to perform similar functions. Specific examples provide a better understanding of the situation. In Production Control, personnel used LOTUS 1-2-3 for such things as production reports, recall rosters, and personnel files; they maintained a job control number (JCN) suffix log with DBASE II and used PEACHTEXT as their primary word processing software. Ground Support Equipment personnel used DBASE II for training records, tool inventory, and personnel files, and they maintained their recall roster and process required reports with PEACHTEXT. Some shops utilized PEACHTEXT exclusively for word processing applications, some used WORDSTAR exclusively, and some responded that they used both.

c. Personnel and Training

The survey and subsequent interviews indicated that the rank of those using the microcomputer systems ranged from Lance Corporal to First Lieutenant. The MOSs were consistent with the manning requirements established for those sections.

A large part of the training for the Zenith microsystems was conducted on the job with the use of vendor tutorials and self-teaching from available documentation. The group did, however, request some commercial training for individuals early on during the initial implementation of the Zenith systems. They were also quick to take advantage of courses offered at the recently established IRC. The Information System Coordinator cooperated with the Section Officers in Charge and together they were able to send over 100 Marines to the various courses offered at the IRC during its first few months of operation. The ISC indicated that there was

considerable interest on the part of Staff Non-Commissioned Officers and Officers of the group to take part in the courses being offered. She indicated that scheduling for the training was one of her biggest problems.

d. Preventative Maintenance and Utilization

With regard to preventative maintenance (PM), the research indicated that there was no standard practice within the group. Some of the respondents indicated that they followed procedures outlined in the manufacturer's equipment manuals, but the majority indicated that they performed no PM on their machines, and the ISC was not aware of any such requirements. She further indicated that the systems were under contract maintenance and that there were no significant problems with the exception of the Z-150 maintenance contract which had caused considerable delays in returning some systems to a useable status.

Usage of the microcomputer systems in MAG-16 varied in accordance with the functional area and the time of the month. Half of the respondents indicated that they used their systems in excess of 6 hours per day with a high of 12 hours and a median of about 8 hours per day. The other half indicated a usage between 2 and 6 hours each day. Time on the computer was especially heavy during those periods before required reports were due; most indicated that the end of the month was the busiest time. In all cases output was used and reviewed by the individual shop manager, but close to half of the respondents indicated that they provided information to all levels in the chain of command.

5. **Marine Aircraft Group 39**

a. Organization

Marine Aircraft Group 39 is located at Camp Pendleton about 40 miles south of the wing headquarters at El Toro. They operate the AH-1T and T/TOW attack helicopter, the UH-1N utility helicopter, and the OV-10A and D aerial reconnaissance aircraft. The group has begun transitioning to the AH-1W attack helicopter.

In MAG-39 the ISC was a Captain whose primary duty was Group Fiscal Officer. She had a bachelors degree in a computer related field and an MBA, but her assignment to this collateral duty was not based on any specific criteria. This officer had no formal schooling related to her ISC responsibilities but was scheduled to attend the Automated Data Processing Course given at the Marine Corps Development and Education Command (MCDEC) in Quantico, Virginia. Her job as Group Fiscal

Officer required most of her attention; however, she managed to spend at least an hour each day on her ISC duties. In the fiscal section she worked with a Staff Sergeant who had a strong personal interest in microcomputing, and he spent an hour or more each day working on information system issues. Additionally, there was a Master Sergeant with a maintenance related MOS who had been working in the fiscal section, and he spent the majority of his time coordinating the logistics for the microcomputer hardware and software of the group.

In an interview conducted with all three of these individuals they indicated that they were barely scratching the surface in terms of what needed to be done to properly manage the implementation and use of microcomputer systems within the group. The consensus of opinion was that there should be three full-time people working on information system issues. In the case of this aircraft group there was a definite command interest in the use of microcomputers and the Commanding Officer was aware of all requests for new systems. The ISC had specific points of contact in each work section, and these sections came directly to the ISC or her assistants concerning any microcomputer related problems. The ISC reviewed all requests for additional systems and made recommendations to the Commanding Officer for approval or disapproval. There was really no formal review process to determine the actual necessity for automating a particular function - sections initiated requests based on their specific needs. There were no group orders either written or in process pertaining to microcomputer systems.

The Headquarters and Maintenance Squadron (H&MS) used seven microcomputers in the aviation logistics support arena. Six of these were employed in maintenance functions, and one was used in supply. The systems used in the maintenance arena were located in Maintenance Administration, Production Control, (which shared with Power Plants), Ground Support Equipment,Ordnance, Analysis, and Avionics. When we spoke with the ISC she indicated that there were no additional systems pending approval for use in maintenance functions.

Each of the flying squadrons had a Zenith microcomputer in its maintenance administration section.

b. Systems Development

In discussions with the Group Assistant Aviation Maintainance Management Officer, we learned that there was no plan for standardization of software application programs either within the H&MS or among the squadrons in the group.

Further discussions with the Production Control Officer indicated that all programs being used in H&MS were developed locally with the exception of SESS which was being used wing wide. There were some individuals in the group with a personal interest in microcomputers who had devoted a great deal of time to developing particular applications useful to the various shops. In one instance someone had actually brought in their own personal equipment , a COMPAQ Portable, for use in work related activities. The situation in the flying squadrons was similar; the application programs they used were either written in house or copied from someone in another unit who developed application programs that were useful to them. A comment on the questionnaire by one of these individuals expressed some frustration at the lack of a standard program to prevent duplication of effort across six different commands that used basically the same reports.

The Group Aviation Supply Support Center Officer indicated that they had one computer in the supply department which was located in the Plans and Programs Section. This system was shared with the Accounting Section. Again, all applications were based on locally developed programs, and they did not use any standard packages.

Data gathered from the questionnaires and confirmed during the interviews indicated that the following software packages were being used by the group: WORDSTAR, DBASE II and LOTUS 1-2-3; however, each shop did not necessarily have all of these software packages. They were obtained as either a part of the initial issue with the equipment, or through follow on procurement action, or, in some cases, through other channels outside the system. The responses to the questionnaires revealed a wide range of applications for the available software. For example, Production Control used LOTUS 1-2-3 for statistical data, muster reports, aircraft data reports, graphs, message formats and miscellaneous forms. They used DBASE II for recall rosters, PM schedules, and miscellaneous inventory programs. Overall the use of the various software packages was somewhat consistent across the group organization. All of the shops and squadrons that maintained a recall roster did it with DBASE II. WORDSTAR was the standard word processing program in the group; there was no mention of the use of PEACHTEXT by any of the respondents. Within H&MS-39, Production Control, the Analyst, and Maintenance Administration used LOTUS 1-2-3 for some applications. None of the other shops in H&MS and none of the other squadrons in the group indicated that they either had or used this particular software, yet some of the applications could be applied across the board.

c. *Personnel and Training*

The survey and follow on interviews indicated that the rank of those using the microcomputers ranged from Lance Corporal through Warrant Officer. The MOSs were consistent with the manning requirements established for those sections.

All of the survey respondents indicated that their knowledge of microcomputers was based solely on self-teaching, on-the-job-training, and the use of vendor tutorials. In discussions with the ISC the researchers learned that training, although available, was difficult to schedule because of various problems due to location, time, facilities, and people. It was the section head's responsibility to provide for training. They may have known what was available, but in many circumstances the funding was not available nor were they willing or able to break people free to take advantage of it.

d. *Preventative Maintenance and Utilization*

With regard to Preventative Maintenance (PM), MAG-39 had, perhaps, the most active program for maintaining their equipment. The ISC and her assistants recommended to all users that they give their equipment a good cleaning once a quarter, and the ISC provided the necessary materials, in the form of cleaning kits, to do so. As a matter of fact, in a couple of cases where systems were not working and shops indicated that repair was needed, a good cleaning of the disk drive heads solved the problem.

The survey indicated that microcomputer usage for each system throughout the group averaged about 4 to 6 hours per day with a high of 9 hours per day and a low of 1 to 2 hours per day. Usage was fairly consistent throughout the month, although a couple of respondents indicated that it was heavier when required reports were due. In every case the output of the microcomputer systems was being reviewed by the individual shop manager , and at least half of the respondents indicated that reports were generated for review by the Squadron Commanding Officer and Group Staff Officers. Only a few indicated that they provided information to all levels in the chain of command.

C. SUMMARY

There were obvious similarities in the implementation and use of microcomputers for aviation logistics support across the Wing organization, yet each group was unique in many aspects. The following tables provide a summary for comparison of pertinent issues as we approach our analysis of the case.

TABLE 1

ISC CHARACTERISTICS

ALD	CWO-2, Aviation Supply Officer, no formal training
MAG11	Captain, F/A 18 Pilot, no formal training
MAG13	2nd Lt, Aviation Supply Officer, no formal training
MAG16	1st Lt, Logistics Officer, ADP Orientation Course
MAG39	Captain, Fiscal Officer, ADP Orientation Course

TABLE 2

NUMBER OF MICROS

ALD	Uses six systems, none on order.
MAG11	Ten systems in H&MS, 8 on order. Each aircraft squadron has at least one, and additional assets are on order to give each squadron two systems.
MAG13	Seven systems in H&MS, four on order. Aircraft squadrons each have one, a few squadrons have two and there are no additional on order.
MAG16	Five systems in H&MS, four on order. Each aircraft squadron has one, none on order.
MAG39	Seven systems in H&MS, no extra on order. Each aircraft squadron has one, none on order.

TABLE 3

COMPUTERIZATION PLAN

ALD	None
MAG11	Yes
MAG13	None
MAG16	None
MAG39	None

TABLE 4

WRITTEN ORDERS/GUIDANCE

ALD	None
MAG11	Zenith Users Manual, by AMMO
MAG13	None
MAG16	Turnover folders, prepared by ISC
MAG39	None

TABLE 5

SOFTWARE USED

ALD	Wordstar DBASE II and III Lotus 1 - 2 - 3 Peachtext TurboPascal Supercalc 3
MAG11	Wordstar Dbase II Lotus 1 - 2 - 3 Peachtext
MAG13	Wordstar DBASE II Lotus 1 - 2 - 3 Peachtext
MAG16	Wordstar DBASE II and III and III+ Lotus 1 - 2 - 3 Peachtext
MAG39	Wordstar DBASE II Lotus 1 - 2 - 3

TABLE 6

RANKS OF USERS

ALD	Lance Corporal to Captain
MAG11	Lance Corporal to Captain
MAG13	Lance Corporal to Master Sergeant
MAG16	Lance Corporal to First Lieutenant
MAG39	Lance Corporal to Warrant Officer

TABLE 7

TRAINING

ALD	OJT/Tutorials Selected Individual Training IRC
MAG11	OJT/Tutorials Selected Individual Training IRC
MAG13	OJT/Tutorials Selected Individual Training IRC
MAG16	OJT/Tutorials Selected Individual Training Extensive use of IRC
MAG39	OJT/Tutorials Selected Individual Training IRC use limited due to isolation

TABLE 8

PREVENTATIVE MAINTENANCE PLAN

ALD	No standard plan
MAG11	No standard plan
MAG13	No standard plan
MAG16	No standard plan
MAG39	Active Program

III. 3RD MAW, THE ANALYSIS

The purpose of this chapter is to present our analysis of the case at 3rd MAW. Prior to the analysis, we introduce ideas pertinent to the study of information systems. The theories and postulates presented help to attach meaning to the basic structure we have chosen to support our research.

A. THEORETICAL BACKGROUND

1. Information Society

Why are we concerned with the implementation of the Zenith microcomputers that is taking place in the aviation logistic elements of the 3rd MAW? Succinctly, the concern is based on the proliferation of information processing capabilities and the lack of understanding of how to use and manage it.

> We are drowning in information but starved for knowledge. This level of information is clearly impossible to handle by present means. Uncontrolled and unorganized, information is no longer a resource in an information society. Instead, it becomes the enemy of the information worker. Scientists who are overwhelmed with technical data complain of information pollution and charge that it takes less time to do an experiment than to find out whether or not it has already been done. [Ref. 17: page 17]

As a microcosm of the society in which we live, the military is confronted with the same issues. Advancements in technology have provided the armed forces with enormous data processing capacity, but how much is required and how should it be employed? This information processing capability will be a basis for power; its very foundation must be firmly rooted in sound theory and practically implemented with careful consideration of the true requirements. The haphazard and uncontrolled implementation of any computer assets could cause more problems and confusion than their utilization will resolve.

There is a very real need for a method to control the technologies of today's automated data processing equipment, in particular those relatively inexpensive microcomputers that are becoming known as End-User Computers.

> Change is occurring so rapidly that there is no time to react; instead we must anticipate the future. With the new information society, then, there is a change in time orientation as well. [Ref. 17: page 9]

The use of the microcomputer must be oriented toward the future. This new and versatile tool must be used to help the military adapt to the very changes that are brought forth by rapid technological growth. The microcomputer is an implement for adaptation and change, and its use, if properly developed, can provide for a more effective and efficient employment of human and material resources. The computer age is upon us. Our lives are touched in many ways by this evolving technology and we can ill-afford to allow it to choose its own path for the future.

2. Information Systems Environment

One of the key elements in the Open Systems Model is the environment of the organization. In the world of information systems there are four major classifications of environment: strategic, turnaround, factory and support. [Ref. 18: pages 26-27] The reader should not be misled, as the names for the environment, if taken in their literal sense would be confusing. There are several reasons for classifying information system environments, but this explanation will be made after the environments are defined.

a. Environments

(1) *Strategic.* The strategic environment exists in organizations that require automated data processing for the effective and efficient day to day operations of the unit. The computer capabilities are critical to the overall competitive position of the organization and paramount to the accomplishment of the organization's continued success. In this type of organizational environment long and short range information system planning is essential. This planning needs to be done at the senior management level with the inputs of the person responsible for data processing.

(2) *Turnaround.* In this information environment the organization obtains and requires automated data processing support, but it is not totally dependent upon it for the continued operations of the unit or the achievement of long/short run goals. Although the organization is not currently dependent upon the services of the computer, there are vital applications under development that will make the organization recognize how essential the technology will be to strategic objective attainment in the near future.

(3) *Factory.* The factory environment reflects organizations that need and are receiving cost effective automated data processing. This environment exists for organizations that require a high level of reliability in the computer services it receives in order to continue its day to day operations, but the services are centered around maintenance applications. Since the applications are not oriented toward the core

decision making of the organization, they are not vital to the competitive position of the unit.

(4) *Support.* This environment implies that the organization may or may not have an immense data processing budget, but automated data processing capablity is not vital to the overall operations of the organization. Data processing support is considered nice to have but it is not essential to the accomplishment of the unit's objectives and or maintenance of its strategic position. Additionally, the applications of the data processing unit are not focused on vital problems.

b. Environmental dissonance

The information system environment needs to be identified when one is conducting an analysis of a system. A multitude of problems may arise when a computer system is being implemented or after the implementation has taken place. A key reason for some of these difficulties may be the result of what the we have termed environmental perceptional dissonance. This occurs when the top level managers of an organization perceive that an automated data processing capability is not strategic to the organization, but the lower level managers who employ automated systems in their units have a different perception of their importance. This difference can also occur in a reverse perspective, that is the data processing capability or information services system can be viewed as vital to the organization, when in all reality it is functioning in one of the other information environments. Environmental dissonance may also be viewed from a third perspective. The actual information system environment could be different from what is being perceived by all members of the organization. One should ask what problems each type of dissonance may cause. Some of the resultant issues could be improper expenditure of funds for equipment that is not needed, or the failure to budget for the purchase of automated data processing equipment that may be vital to the continued accomplishment of the organization's mission in the future. Just imagine the future state of military preparedness without proper forecasting of our strategic requirements. There have, of course, been many times when the military has fallen short in this area, but with the information revolution now taking place, it is vital that perceived environmental dissonance be given careful consideration.

3. Microcomputer Growth-Nolan's Computer Growth Model

Another key aspect of the Open Systems model is the area of technology; of particular importance is the manner in which an organization assimilates new technology and fosters its growth. There are six phases of data processing growth that

are directly related to the manner in which modern computer technology is brought into the fold of an organization. Richard D. Nolan[5] has labelled these phases as initiation, contagion, control, integration, data administration, and maturity. [Ref. 19] Using these six phases as guidelines, a manager can ascertain where his organization is located along a developmental and technological continuum. In being able to make this judgement, the manager can look at individual characteristics of each phase and forecast future trends and organizational needs. We will use these six phases of data processing growth in our analysis of the aviation logistic support elements of the 3rd MAW. Prior to this analysis it is necessary to shortly define each phase.

a. Phases of Growth

(1) *Initiation.* In this first phase a decision has been made to commit funds to the acquisition of data processing equipment (microcomputers) and management has determined that there exists a degree of latitude as to the urgency of their implementation. The microcomputer is being used as a tool to automate low level functional tasks. This is done usually without appropriate knowledge of systems development and without an awareness of all costs involved. Training of qualified personnel to operate and program the microcomputers is a cost that is not throughly evaluated. This phase is also characterized as lacking in planning and controls for the processes being automated. An introduction to the world of data processing actually occurs in this phase.

(2) *Contagion.* This phase is characterized as one pumped full of energy, euphoria abounds over the new found technology (by those who accept its capabilities). Management starts looking for many more ways to capitalize on the computing power of its equipment. Users of processed information now start offering ideas on new applications, the computing power of the organization is viewed by members of the organization as a panacea for organizational ills. The entity allows the microcomputer to proliferate with few controls and no planning. Innovation is the key word in this phase of the growth cycle.

(3) *Control.* After the period of proliferation, management realizes that there is a need to control the activities associated with automated data processing. There is now an interest as to who gets the finished output from the systems, who

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[5]Mr. Nolan is chairman of Nolan, Norton & Company in Lexington, Massachusetts. He formerly taught at the Harvard Business School where he held the position as an Associate Professor of Business Administration. He taught courses in data processing and has conducted extensive research in the data processing field.

regulates their operations, and who determines what functions and/or jobs are to be automated. Before, anything goes was the word; now formal planning is encouraged and implemented with long and short range goals being established. Data processing expenditures are watched to assign or establish accountability for their proper use. Where no control encouraged new and innovative microcomputer uses in the contagion phase, too much control could serve to stifle these creative powers. For these reasons, care is taken to regulate and control with common sense. It should be noted that very few new applications are born in this phase.

(4) *Integration.* The integration phase is depicted as one where existing applications are fine-tuned and a control system is established to manage the system configuration. This is a period of transition from a non-strategic environment to an information system environment that is vitally important to the organization. Planning is specific to each new and current application, that is plans for updates, new releases, and system changes are actually planned for and controlled. The idea of data bases may be introduced and user accountability is stressed. Programs and applications are shared across intra-organizational boundaries and software sharing teams can be formed.

(5) *Data Administration.* This phase brings a new concept to the organization, an idea that data processing is not all programs and computer hardware, but that it also is heavily dependent upon the management of the form and types of information that are produced. There is an awareness that data is being shared across the organization and when manipulated, it could prove to be strategic to more than one unit of the enterprise. Effective accountability is established and all managers involved with the data processing (microcomputers) realize the importance of these capabilities to the organization. In this phase of growth, controls are enacted that govern the flow of data and its form/content. One common solution could be the development of a comprehensive data dictionary. This phase is one that is difficult for a segmented organization to fully realize.

(6) *Maturity.* The maturity phase is marked by total information resource management. The planning for automated data processing is of vital importance in the organization and could possibly effect the continued existence of the organization. The users of the processed information share jointly with the data processing personnel the responsiblity for all that happens within the computer systems. There is a sense of total integration of all applications, and the data reflects

the structure of the organization. The demand for the computing power is balanced with the offered supply, with a high degree of control being exercised over data structure. This phase is one that Nolan believes has not yet been attained by any organization.

b. Phase Evaluation

The six phases of the computer growth cycle and their subsequent evaluation, can provide valuable insight into the perceived development of an organization's automated capabilities. By understanding Nolan's model for computer growth, the manager can look toward the future and plausibly predict where the organization is headed with its data processing functions. The recognition of the subtle transition from a program and hardware orientation to a data management focus is vital for cost efficient operations. The training of personnel is also dependent upon where the organization is directed. The manager of an organization must be aware of the future needs of the enterprise. An awareness of the current technologies and their apparent capabilities is of paramount importance in the proper management of available microcomputer assets. The acceptance of this technology is of the same importance as the awareness of its power. The proper placing of ones organization on the phase continuum can enable the manager to ensure that the appropriate type and amount of planning is conducted for continued computer system development and growth toward maturation.

There may be stumbling blocks to the acceptance and growth of the microcomputer and other data processing innovations. The manager needs to be aware of the necessity to educate those who shun technological advancements. Possibly Kurt Lewin has the answer in his theory of change acceptance. That is, there must be an unfreezing of the old attitudes and ideas, accompanied by a motivation toward the future with new methods. Next there must be a movement or actual changing of methods, a new way of doing something. The change can be a technological, structural and/ or people oriented, or may involve some combination of these methodologies. The final aspect is a refreezing of the new skills, attitudes, and methods. This implies acceptance and permanence of the technological advancement. [Ref. 20: page 526]

c. The Merging of Technologies

Beside the problems of technological change and its acceptance, there exists another more complicated problem. In the past there has usually been a clear

separation between data processing (computing), telecommunications, and office automation. This separation is now less clear. the personnel who were known as computer operators are now losing their special status. The office typist (secretary) is being elevated to a more prestigious position and the telecommunication personnel are being called upon to learn many new facets of the operations of the organization. There is a melding of the three technologies, but it is not clear how successfully it is taking place. Cherry Freeman has made the following comment about the merging technologies. [6]

> "Data processing isn't DP anymore. Word processing isn't WP anymore. Now it's time for something called integrated information processing. We're dealing with multiple forms of information, and we're moving toward an office environment where a single device will perform a variety of functions." [Ref. 21]

The merging of these three technologies poses special problems for the manager when attempting to evaluate where the organization is in the Nolan model of computer growth. An additional complication arises from the possibility that the organization could have several departments or divisions that are implementing or already using microcomputers, minicomputers, and mainframes at different places and for various applications, all at the same time. The organization, taken as a unit, therefore, could be in many different phases of growth at the same time. A special set of problems arise when there is a multi-phased growth cycle occurring in conjunction with the merging of the three key technologies. How does the manager lead and guide the entity toward the maturity growth phase? There are no clear answers to this question, but, the manager needs to be aware that the merging of the technologies will effect the

structure of the unit and the personnel who perform the associated functions of the key technologies. Where before the skills required of each technology were distinct, there will now be an increased demand for the worker who knows it *all*. This demand will be for the people who know and understand the fundamentals of data processing, the details of office work, and the dynamics of basic wire communications technology. These types of people are now in short supply and as the merging of the technologies occurs, so to will be the knowledge needed to make these technologies perform. As the price of computer hardware continues to decrease and the utility of software increases

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[6]Cherry L. Freeman is the program manager for communications corporate program management at Burroughs Corporation.

with new innovation, the demand for these technological specialists will continue to grow. [Ref. 18: pages 71-75]

Additional problems are created for the manager by merging of the technologies. How will the manager ensure that organizational information is used only by those who are authorized? Who will set the policies about how the computer systems are to be used? What types of information will the unit be allowed to process? What are the important jobs in the organization? Who will be in charge of quality control of the processed information? Who gets a computer? Who will be wired into a network? Does the entity need to have a network? There are a multitude of questions that need to be dealt with. The problem is immense. The real issue is how does one manager/leader deal with the intensity of the merging technologies, the proliferation of the data processing assets, and the need to efficiently and effectively control the organization?

B. COMPARATIVE ANALYSIS

In the first phase of the analysis for the case of microcomputer implementation and use in the 3rd MAW we consider several aspects of the environment. In looking at this element of the open systems model, we consider the role of the WISMO in structuring the information systems environment and fostering computer growth and the role of the ALD in terms of establishing policy for automation of aviation logistics support functions. We also define the information systems environment and phase of growth within the ALD and each of the groups. In the second phase of the analysis we will consider the overall perception of microcomputers, the potential for perceived environmental dissonance within each unit, and the impact of merging technologies on the structure and function of the organization. Finally, in the third phase we look at the implementation of microcomputers for aviation logistics support in the 3rd MAW with regard to a standard model for computer systems development and implementation.

1. Environment

a. The Role of the WISMO

The introduction of Zenith microcomputers into the 3rd MAW broadened the scope of the WISMO's responsiblity and necessitated changes in the overall wing environment. In the past, the WISMO was not greatly concerned with the ADP requirements of aviation logistics support functions. As indicated in the case,

programs such as SUADPS-RT and NALCOMIS came solely under the purview of the ALD largely as a result of existing staff relationships; specifically, a feeling that those systems are peculiar to aviation and best handled by the elements they are designed to support. It is not our intention to discuss the merits of this long standing relationship, but simply to state that the introduction of microcomputers into the aviation logistics support arena more closely involved the WISMO with these functions. The changing nature of the WISMO's job placed an increasing demand on its resources. Not only was the WISMO concerned with its traditional functions, but now it was involved with the large scale introduction of microcomputers throughout the Wing. In addition to providing assistance for the systems being introduced for aircraft maintenance and material support functions, the WISMO was deeply involved in a major project to develop a local area network (LAN) for a variety of applications to support the General's staff. These developments added to the WISMO's job, but they had not been accompanied by a corresponding increase in the number of assigned personnel dictated by the Table of Organization (T/O); a request to revise the T/O had been submitted but had not yet been approved. At the time we conducted our research, the WISMO provided assistance in the procurement, distribution, and maintenance of microcomputer systems, but its ability to offer any support beyond these basic functions, particularly in terms of training and system development, was severly limited by the size and experience of the staff. This situation had a definite impact on the perceived importance of microcomputers to support any function throughout the wing both in terms of the information systems environment and the phase of computer growth.

b. The Role of ALD

What had been the role of the ALD with regard to microcomputer implementation within the aviation logistics support elements across the Wing? Their approach to this issue might best be characterized as one of gentle encouragement and general non-interference in terms of establishing a wing wide approach to the construction of an effective system. Although there had been a few initiatives to establish a standard approach to system development such as the Zenith 120 Users Conference held in May 1985, there was no follow up meeting due mainly to operational considerations and the attending resource constraints.

In their capacity as a staff section, the ALD should not necessarily be responsible for system design and development, but its policies should provide

direction, and its ability to interface with each of the groups should give it insight into the success of individual ideas at the group level which would be effective for wing wide application. This does not appear to be the case when looking at the IS environment and phase of computer growth in each of the subsystems defined in our study.

c. Information Systems Environment and Phase of Computer Growth

The information systems environment and phase of computer growth for the ALD and each of the groups in our study was unique. Some of these units were categorized in the same environment and phase of growth, but no two were really the same in every aspect of the classification.

(1) *ALD.* As discussed in the case, the ALD used six microcomputers throughout the department. The role of the ISC was largely one of support concerning the maintenance and material requirements for the system hardware and the procurement of commercial software packages. There was no existing policy aimed at standardization and development of an integrated system for the department as a whole. Each division that employed a microcomputer (and not all of them did) had developed its programs independently, with a variety of different software packages, for use in applications pertinent to its particular function. The programs which were being used were oriented toward the maintenance and support of departmental tasks, and although they provided a large measure of efficiency in terms of a reduced workload for compiling and maintaining data and readily available information for making management decisions, they were not yet critical to the ability of the department to perform its day to day operations. For these reasons we would classify the information systems environment here as a factory environment. With regard to Nolan's model, many of these same factors seem to indicate that the ALD was still somewhere in the initiation phase of computer growth.

(2) *MAG 11.* In MAG 11 the information systems environment was quite different. Although the ISC was mainly concerned with procurement, distribution and system maintenance issues, the Group AMMO orchestrated a well-defined computerization plan that outlined specific goals and objectives for the implementation and use of microcomputers in aircraft maintenance and material support. This plan called for the development and use of an integrated system of application programs built with a common software package. It defined a system designed on a modular concept; as such, new applications could be easily developed and readily integrated into the system, giving it tremendous flexibility and growth potential. MAG 11 intended to

implement this system within H&MS and eventually throughout all the aircraft squadrons in the group. Concurrent with the development of this computerization plan was the implementation of an idea which the MAG 11 AMMO refered to as the Logistics Control Center. This concept established a central repository of aviation logistics information for all squadrons that would aid in the overall decision making process for the group. MAG 11 recognized the potential of microcomputers for aviation logistics support, and they began to develop program applications important to their short and long-term goals. Although the organization could continue to function without this support, it had become increasingly important to the degree of success which they wished to achieve. Planning was a key element in this group and there was heavy commitment on the part of senior management. We feel that the information systems environment was this group is between turnaround and strategic. They passed through the first three phases of Nolan's computer growth model and were in the integration phase of growth at the time we conducted our research. They established a standard for system development based on a database application and had specific plans for expansion of system capabilities putting them on the verge of transition from a non-strategic to a strategic environment.

(3) *MAG 13.* MAG 13 had a definite interest in the use of microcomputers to perform many of the routine functions involved in aviation logistics support. This was evident from the fact that they employed seven microcomputers in H&MS and had requested additional systems to augment the existing potential in the IMA. Although senior management saw them as "nice to have", interest in the group seemed to be concentrated among the junior officers and senior staff NCOs - more particularly among the staff NCO's who not only oversaw their operation but used them as well. The ISC was concerned with procurement, distribution and maintenance issues only and was relatively new to the organization and the Marine Corps; his appointment was indicative of the degree of emphasis that senior management placed on the implementation and application of microsystems. As the case indicated, the microcomputer applications were, for the most part, constructed independently and there were no plans for standardization and development of an integrated system that would have group wide application. The programs which were being used had been developed with a variety of software packages and their orientation was directed at routine functions that enhanced efficiency in terms of clerical workload and ready availability of management information. The systems were definitely an asset to the

organization, but were not critical to the ability of each section that used them to perform day to day operations. The information systems environment in MAG 13 was best classified as a factory environment and the phase of growth within the Nolan model most closely approximated the initiation phase.

(4) *MAG 16.* There was obvious enthusiasm at all levels of the organization in MAG 16 regarding the potential of microcomputers for more effective and efficient operations. The large number of people that the group sent through training classes offered by the IRC at MCAS El Toro was indicative of this intense interest; so to was the fact that the ISC attended formal Marine Corps training related to her responsibility. The ISC was involved with procurement, distribution, and maintenance concerns, but her efforts also addressed training and related issues. She spent a significant amount of time on this collateral duty but thought that much more should be done. Although, at the time of our study, there was no plan for standardization of software and application programs within the aviation logistics arena, both the AMMO and the Supply Officer recognized the potential of the systems to enhance their support capabilities. The participation of their departments in the large training effort of the group was indicative of this awareness. We feel that MAG 16 was in a factory information systems environment and the contagion phase of the Nolan growth model. Although they were increasingly aware of the capability of microsystems and they used them extensively throughout the group, these computers were not vital in the day to day operations. Enthusiasm and energy abounded, but there were still few controls and little planning to govern microcomputer implementation and system development.

(5) *MAG 39.* The task of coordinating the implementation and use of microcomputer systems in MAG 39 was a serious concern. The ISC attended formal training related to this responsibility and there was a definite command interest regarding information systems. There were three people in the group that worked directly with microcomputer issues, and collectively they felt that much more should be done. These factors considered together emphasized the awareness of this group regarding the potential of microsystems. Discussions with the AMMO and the GASSCO and a review of the questionnaires that we distributed pointed to the beginnings of standardization in terms of software packages used in program development. We emphasize beginnings of standardization because there was still no plan for standardization of applications across the group, but there were shops working

together and sharing system assets. We classified this group in an environment between factory and turnaround because they appeared to be on the verge of encouraging the development of vital applications. They were in the contagion phase of computer growth because there was tremendous enthusiasm with few controls and no formal planning. There were indications, however, that they would soon transition to the control phase of growth. Our discussions with maintenance personnel and some of the survey comments indicated concerns regarding the lack of standardization. These concerns could give rise to some form of a computerization plan for the group.

2. Perception of Microcomputers and the Impact of Technology

a. Potential for Environmental Dissonance

At the time of our study, we thought the presence of dissonance within the aviation logistics elements of the 3rd MAW was minimal, although there were several areas within each of the subsystems, that is the ALD and the individual aircraft groups, which could give rise to points of concern. Generally, the personnel within the aviation logistic elements recognized the capabilities of their Zenith microcomputer systems and the importance they served in the accomplishment of the support mission.

The ISCs of the ALD and each of the Groups came from varying backgrounds and represented a mix of military occupational specialties (MOS). Although there were some Zenith microcomputers in other functional areas of each group, the majority of the systems were used for aviation logistic functions. Since the preponderance of the systems were serving in this support area, one would expect that the persons responsible for their management would have an MOS related to aviation maintenance and material support. In two of the units in this study the ISCs did have aviation supply MOSs. In the other three units the ISCs were an aviator, a non-aviation Logistician, and a Fiscal officer. Even though these three did not have an MOS related to aviation logistics, they all had some educational background in computer management or computer science. This presents a dilemma as to who should be the ISC of an activity? Should the ISC be an individual who is knowledgeable in the technical area where the microcomputers are being heavily used, or should the ISC be someone who has an educational background in computers and information processing? This question deserves careful consideration, and we will address it in our recommendations.

Another area of potential dissonance exists within the aviation logistic support structure itself. If senior management, i.e. the AMMO and the GSO, do not

recognize the potential of microcomputers, they have the power to limit their application and use, as well as discourage innovation. The majority of applications that we observed were developed by junior enlisted personnel or SNCOs with a personal interest in computing. Without the backing and support of the department heads for aircraft maintenance and aviation supply, the power of these individual applications may not be realized, and the potential of the individuals who designed them may not be fully developed for the good of the organization.

b. Impact of the Merging Technologies

In the aviation logistics units of the 3rd MAW there was a merging of two of the the three technologies that were mentioned earlier in this chapter. The microcomputer has brought the world of data processing to the desktop of every Marine involved with aviation logistics support. Data processing (computing) and regular administration functions were being combined into a singular integral job within the aviation logistic elements of the study. Although the Zenith microcomputer systems were originally purchased as word processing equipment, additional uses continued to evolve; several of the units in the study were moving toward data base applications and spreadsheet manipulation. Data were being input, processed and output in useable form as information for the participating units. Before the widespread use of word processing the clerk in the organization had to know only about the correct format of military correspondence; now that same individual had to be knowledgeable as well about a variety of software and other components unique to computer technology. Mastering the use of microsystems places new demands on the young Marine and at the same time provides access to much more information than ever before.

The merging of the administrative and organizational data processing functions is also having an impact on the traditional roles of individuals in the military. The introduction of microcomputers in the 3rd MAW showed indications of this change. The role of the officer and the staff non-commissioned officer is to train and supervise subordinates; this role could be affected by the introduction and continued growth of microcomputer applications. In the past the operational aspects of data processing were serviced and performed by junior enlisted personnel (sergeants and below), with SNCO's and Officers supervising the overall operation and analyzing the output. With the merging technologies, this clear separation of duties seemed to be dissolving. As the computing power of the microcomputer was assimilated at all levels

of the organization, there were Officers and SNCO's performing operational tasks that were once the responsiblity of their subordinates. These new technologies and their subsequent merging was awakening a desire in the leaders to become involved with them in all of their aspects, but it gave rise to the question as to whether their involvement was taking the proper form. What was once the domain of the young Marine sometimes seemed to be invaded by the person or persons who were ultimately responsible for their training and supervision. The question that must be asked as more and more microcomputers are scheduled for delivery to the operating units of the Marine Corps is at what point do the leaders become less effective as their own interaction with the microcomputer increases? When is the tedious point reached where the leader's involvement with the melded technology becomes a detriment to the accomplishment of the unit mission? Who is perpetuating the Marine Corps' teacher-student philosophy while the leaders are sitting at the microcomputer keyboard? These are difficult questions, but the issues are important to effective management and leadership.

Consideration of the third key technology, that of data communications, gives rise to additional questions. When we conducted our research there were frequent references to eventually incorporating this capability into local networks in support of aviation logistics functions. At the time of our study, there were no active microcomputer data networks set up for this purpose, but the potential for their use was certainly a viable consideration. The implementation of communication technology presents a completely new set of problems. The Wing will have to develop plans to safeguard information that is being used in the microcomputer systems once a communications capability is introduced. Not only must the information be protected, but somebody will have to decide who is allowed access to stored data. There will have to be decisions made as to what types of data will be stored and processed on the complex systems resulting from the merging of office automation, data processing and communication technologies. These are all issues that require thought and planning before any implementation occurs. The successful development of any system or the enhancement of its capabilities calls for some general guidelines or a model to follow in a step by step process.

3. General Model of Computer Systems Development and Implementation

There are several reasons why strict adherence to this general model in our analysis of the implementation and use of microcomputers for aviation logistics

support functions is difficult to accomplish. First of all, the original distribution of the Zenith microcomputer systems was mandated from command levels above the 3rd MAW. Secondly, each step or stage of the implementation model has detailed requirements for evaluating computer hardware, data, software, personnel, and written procedures/documentation. These essential elements of the model and their subsequent evaluation is made difficult by constraints imposed by the structure of a military organization and the general policies dictated by the government pertaining to methods of decision making. The model is, however, flexible, and we have been able to manipulate it to provide a workable analysis of the situation in the 3rd MAW at the time of our study.

a. Requirements Stage

This stage of development dictates the formation of a project team, whose member composition should include at least one user of the anticipated system. In this case, the forming of a project team may have been accomplished at a higher level of command - there was not one formed at the 3rd MAW, at least as far as the original implementation was concerned. There have been follow on orders to the original distribution, but no new systems have been designed or implemented that would have required the designation of a local project team.

A clear definition of the problem to be solved or served by the design and implementation of the microcomputer system would require that the forecasted end users of the system provide input for the problem definition. This may have been accomplished at another location, but we could find no evidence in the 3rd MAW which indicated that personnel associated with aviation logistics support had been asked for their inputs prior to the initial delivery of microcomputer systems. As a matter of fact those personnel that were aboard station when they were delivered did not have clear direction as to where the systems should specifically be employed. The lack of user input in the development and implementation of computer systems can be one of the central reasons for an unsuccessful computer implementation; therefore, user participation in any implementation should be a primary concern.

Considering the implementation at 3rd MAW, this stage seems to have been bypassed in the original distribution of the Zenith microcomputer systems. The requirements stage of the model may need to be modified to allow for the constraints imposed by military procurement methodology. The WISMO could play a key role in this stage of system development and implementation. Although units must delineate

clear requirements to obtain additional microcomputers, they still must organize their organic assets in accomplishing this task and the WISMO could offer valuable assistance in this regard.

b. Alternative Stage

In this stage of the development and implementation process the organization should generate a variety of alternatives that would solve the defined problem and specified requirements. The alternatives should include options that require the use of a computer as well as alternatives that do not depend on automation. One of the alternatives should be selected after a complete analysis of the costs and benefits are considered. The alternative should specifically consider configured hardware components, personnel requirements, data formats, procedures documentation, and necessary software. If the selected alternative is feasible and requires the capabilities of a computer then the process should continue, with management or leader approval. We found no evidence that this type of process was followed at the 3rd MAW level, although it may have been done at a higher level of command.

There are indications that cost/benefit studies were conducted within 3rd MAW for the purchase of replacement and supplementary microcomputer assets. It is important to consider the artificiality of some aspects of doing a cost/benefit analysis for government agencies. Conducting a cost/benefit analysis for a "for profit" organization can be an effective way of evaluating alternatives, but can be suspect when attempting to derive realistic results for a non-profit organization. In particular, the government is not in business for profit and how can we realistically assign a dollar value to the services performed in support of national defense? What is the value of enhancing operational readiness? The time tested cost/benefit analysis may not be pertinent to the justification process for automating the support apparatus of our armed forces. We may have to look past the superficial benefits of the costing system being used to justify the microcomputer purchases and attempt to assess the real net worth of their contribution to the aviation logistics arena in the 3rd MAW.

c. Design Stage

We found that the aviation logistics units of the 3rd MAW really had not had the opportunity to participate in the overall implementation planning for the Zenith microcomputer systems. The requirements and alternative stages were completed at a level of command several steps removed from the immediate users of

the system, those personnel who could identify the needs of the organization. In the design stage however, each unit had the opportunity to somewhat control part of the development and implementation process. Although the logistics units must order their hardware from a GSA schedule for follow on orders to the original systems, they have some freedom in the composition and configuration of the system based upon what components are available in the supply system. There are ways that the users can modify current and future systems. They can purchase chips to expand memory or they can order and install a hard disk, both of these options allow the user to alter the capabilities of the original system. They can also select one of several different printers, depending upon their perceived needs. This flexibility is one way they can influence the design stage; however, if not properly controlled this flexibility can lead to problems in configuration management.

In addition to limited flexibility in determining hardware configuration, the users have some latitude in choosing the software they employ. The original issue of Zenith microcomputers included some standard software packages, but the users in the 3rd MAW were innovative in acquiring a variety of software. There is a wide selection of software that can be purchased, from the same GSA schedule that lists the hardware components, however the purchase must be justified and many of the users were unaware of the capabilities that some of the commercial software packages offer. As a result, they may not be using what is best suited to their needs. This gets into the issue of training which we address later in the analysis.

One group in particular was actively attempting to design their own functional microcomputer system, although they were limited by the components available on the GSA schedule. Within the aviation logistic support functions of MAG 11, the AMMO and his staff, were planning and implementing application programs and designing a system utilizing database software. They formatted data and documented, their procedures as called for in the model. This group's efforts were well organized. They developed a realistic computerization plan and even had the benefit of professional assistance in the form of a Naval Reserve Officer with professional expertise in this field who was able to provide consulting services in his capacity as a reservist. We would point out that what was being done at MAG 11 within the aviation logistic support arena appeared to be a step in the right direction regarding the process of designing and implementing a microcomputer system, but the Group's ISC and the WISMO were largely unaware of this progress. The ALD and other

groups in the Wing designed various applications but none of them were based on an overall computerization plan nor did they provide for integration of all of the applications into a standard system.

In the effective design and implementation of a microcomputer system, one of the weakest areas was the writing of clear and concise documentation. The documentation of both system and user procedures is a tedious and time consuming process that nobody wants to do. Everybody wants to use the system and decrease the manual workload, but it is hard to find someone to write the necessary manuscript that makes the working system a reality. The purpose of systems design is to produce applications that are reliable, readable, and easily maintained. The system must accomplish what it is meant to do and the documentation must lend itself to being easily read and interpreted for ease of maintenance. Design documentation was a weakness in the applications developed for aviation logistics support functions across the 3rd MAW. Although some documentation had been written and one of the groups, specifically MAG 11, had published detailed guides and users manuals, much more needed to be done concerning the documentation of program code. The lack of standard procedures across the wing organization in terms of the software used for development of application programs was one factor that hindered good documentation. Another factor was a lack of specific documentation standards. The attributes for successful system design and documentation should have been given greater consideration throughout the Wing because effective aviation logistics support requires a flexible system that is easily maintained and updated to accommodate changing requirements and the constant turnover of personnel. Proper documentation and trained personnel are integral to the development of a workable system.

Besides the documentation issue, there was a definite problem in the area of training personnel to be computer literate. The idea of "user-friendly" computer systems and applications represent a workable doctrine only if the user has some degree of computer literacy. The user needs to have a basic idea of what the microcomputer is and how it accomplishes its job. If the user does not have this basic understanding of how the system operates, then the user-friendly issue is a moot point. In the Marine Corps a jet mechanic is not handed a tool box and send out to repair an engine without proper training, nor is a machine gunner sent into the field without a thorough working knowledge of how to use and care for his weapon. The same training should have been afforded the technical people who design and operate the

microcomputer assets within the aviation logistics support functions of the 3rd MAW, but it was not being done. There was one unit that was attempting to maximize the number of personnel receiving training for their microcomputers. MAG 16 sent over 100 Marines to formal training to operate their Zenith systems. The other units were trying to get some training in, but they were constrained by competing demands for their Marines' time. The training of personnel associated with these valuable assets is of paramount importance to their role in support of Marine Corps aviation. All things considered, we concluded that training commensurate with the forecasted importance of the Zenith microcomputer systems was not being accomplished rapidly enough to capitalize on their potential.

The last item we considered was preventative maintenance, which in conjunction with proper documentation and training, is vital to the success of any computer system. The proper management of computer assets dictates that a written plan be developed for the support of preventative maintenance of system hardware. MAG 39 was the only unit that placed any consistent emphasis on PM. The ISC was aware of its importance and provided the necessary materials. The concept of PM for microcomputer systems in the other groups was sporadic at best.

d. *Implemention Stage*

The final stage of the development and implementation model pertains to the actual activation of the new system. During this stage the system is connected and tests are made with the data and the application programs. This testing is to be accomplished for each subsystem and the integrated system as a whole. On the basis of our research, we ascertained that system testing was done by the individual who developed the application. That same person ensured that the program ran correctly before bringing it on line to produce output. The application of this stage of implementation theory becomes increasingly more important as the number of microcomputers used for aircraft maintenance and material support continues to grow.

C. SUMMARY

Table 9 provides a summary of pertinent points in our analysis of the case which we address in the conclusions and recommendations of this thesis. These points are not all inclusive, but they do touch on some key characteristics of the organizations.

TABLE 9

SUMMARY TABLE

Information System Environment/Phase of Growth

ALD	Factory/Initiation
MAG11	Turnaround-Strategic/Integration
MAG13	Factory/Initiation
MAG16	Factory/Contagion
MAG39	Factory-Turnaround/Contagion

General Issues

1. Potential for Environmental Dissonance
2. Role of the Staff NCO and Officer in an automated environment

Implementation Concerns

1. Need for proper documentation
2. Need for written guidance/directives/orders
3. Need for standards in software
4. Need for user involvement in system development
5. Need for control of assets/configuration management
6. Need for a training plan

IV. CONCLUSIONS AND RECOMMENDATIONS

The war fighting capability of the 3rd MAW is an important element in our national defense. The modern combat aircraft which they fly represent some of the most advanced weapons systems in the world. In order to maintain the operational readiness necessary to fulfill their assigned mission, the 3rd MAW must have an efficient and effective program of aircraft maintenance and material support. As is true throughout the Marine Corps, the individual Marine is the key to success; however, the individual Marine must be provided with the proper tools and training for the job. Advances in technology have provided the Corps with more potent weapon systems, but the cost and complexity of these systems have also increased the need for better methods of managing the personnel and material resources required to support them.

The microcomputer can be an important asset to any organization. If properly implemented and employed as a management tool, it has the potential to create a more efficient and effective organization for aviation logistic support across the 3rd MAW. All of the organizations in our study derived benefits from the Zenith microcomputer systems that they employed; however, there was a great disparity across the Wing in terms of their contribution to the aircraft maintenance and material support effort. The capability of microcomputers was not being fully exploited, and, in many cases, the leaders were unaware of the microcomputer's potential. Our recommendations address the technical/system development aspects of microcomputer implementation and use, as well as the functional aspects of developing microcomputer applications for aviation logistics support. These recommendations are based on the observations we made during our study; they are guidelines drawn from current theory regarding the use of computer technology for more effective management. The recommendations are as follows:

Technical/System Development

- Develop a general awareness across the Wing concerning the importance of microcomputers as a management tool.
- Develop standards for applications, programming, and documentation.
- Develop controls for data and hardware system management.
- Develop a microcomputer training plan.

Functional Applications for Aviation Logistics Support

- Create a Steering Committee

- Standardize the information system environment for aviation logistic support across the Wing and bring all Groups, to include the ALD, into the same phase of growth as defined in the Nolan model.
- Develop a plan for a standard system of applications for aviation logistic support.
- Assess the training needs of System users and coordinate requirements with the WISMO ISCs.

Each of the recommendations are discussed in the following paragraphs.

A. TECHNICAL/SYSTEM DEVELOPMENT

The role of the WISMO and the ISC must continue to expand. Rapid advances in computer technology call for a continual development of professional skills. With the growth of microcomputer applications and new system acquisitions, these personnel must be relied upon to provide guidance and a knowledge base for the system users.

1. Develop awareness

In their expanded capacity, the WISMO should assume the responsibility for generating awareness throughout the Wing as to the capabilities of the microcomputer systems currently employed in the organization. There are many ways that awareness and interest can be cultivated. The WISMO could plan and implement a seminar designed to educate Wing Staff Officers, Group Commanders, and Group Staff Officers regarding the capabilities and potential that microcomputers offer for more effective management of personnel, money, and material resources. This is perhaps, one of the most important points; the leaders of the organization must be aware of and support microcomputer implementation and use. Without the endorsement of unit leaders, the program will stagnate. The WISMO could stimulate general interest by sponsoring a microcomputer fair open to all Marines; this project might be done in conjunction with the Regional Automated Services Center. The WISMO could bring in an outside consultant, or develop on their own, one day mission oriented seminars that stress practical applications for mid-level managers and system operators. We would stress that the creation of this general awareness will require an on-going effort if it is to be successful. The WISMO should enlist the aid of the ISCs in each Group in this endeavor, incorporating their ideas in his plan of action.

The role of the ISC is important to any effective program of microcomputer implementation and use. The ISC's position, role, and responsibilities in an organization are indicative of the general degree of emphasis that a unit commander

assigns to computer assets. If the ISC's functions are clearly defined and the ISC is in a position to continually stimulate organizational awareness, the overall program in the Wing can be more effective. Who should be appointed to fill this important position in each Group and what are the appropriate responsibilities? We think that the future importance of the microcomputer dictates that the ISC duties be assigned to the Maintenance Management Officer (MMO) of each group. Since the microcomputer systems are valuable pieces of equipment, it makes sense to assign their management to the officer who already has much of the asset management responsibility of the unit. The MMO is acutely aware of the Marine Corps regulations concerning the proper management and maintenance of material assets across the entire organization. The assignment of the MMO in each unit would serve to standardize the duties and responsibilities, fixing the collateral duty to a specific billet Wing wide. The WISMO should ensure that the ISC's duties are clearly delineated and that they are throughly familiar with the importance of their position in the information systems environment. They should receive formal training to develop a degree of technical proficiency and to be more effective in their job.

The responsibilities of the ISC, as far as aviation logistics is concerned, should be one limited to assisting the unit commander in evaluating procurement requests and management of physical assets. The ISCs should also be aware of end user applications, but only to the point of being informed, not to the point of providing specific direction. They should also actively advise their commanders of the current microcomputer capabilities and proposed innovations. In this capacity ISCs could serve as an effective extension of the WISMO.

2. Standards for Applications, Programming, and Documentation

The WISMO should provide the entire Wing with published standards for the development of applications, programming, and system documentation. The Groups do not possess the necessary personnel with appropriate training to properly design their own individual standards. The actual tasks of structuring and designing applications and writing programs and the proper documentation should be standardized and published in a guide for the user. The guide should provide a step-by-step methodology beginning with problem definition and ending with system implementation. There was no consistent policy to ensure an adequate job. If such a guide is published, it should not stifle the Groups in their creativity, but will serve to foster new ideas and help to provide a systematic way for them to properly apply their microcomputer assets.

Programming standards should encourage the use of standard software packages for particular applications. There was a variety of software being used throughout the Wing; however, the majority of applications had been developed using three or four standard packages. The use of standard packages offers several advantages: the development of a more effective training program, the development of modules with more general applicability, more consistent programming allowing for easier maintenance, and a broader range of ideas and approaches to particular problems. The use of software standards should also encourage better documentation.

The documentation developed for an application is critical to its life cycle. Since high turnover is common in military units, it is vital that all applications be accompanied by proper documentation. After the program is complete, another computer literate Marine should be able to read the documentation and find the answer to any question that may arise. The Marine should also be able to see a copy of the written computer code and be able to follow its logic. This will aid in any application changes that may have to be made after the original developers have departed the organization. Supporting documentation should accompany even simple word processing applications used to produce standard letters or reports.

Standardization is an essential element in system design and development. It can help to alleviate confusion and discouragement.

3. **Develop controls for Data and Systems Management**

Effective controls are an essential part of any program. The WISMO should ensure the development of a mechanism to govern data and hardware system management. Both of these aspects of control require serious consideration by the WISMO.

During the course of our study we noted a wide variety of data control measures, none of which are wholly adequate. In establishing measures for data control the WISMO should concentrate on data security, data access, and back-up and recovery procedures. The need for data security is obvious. Not only is control of classified information a serious concern, but there is a considerable amount of personal information on individual Marines being stored on computer disks. Procedures should be reviewed to ensure compliance with Privacy Act requirements. The WISMO, in conjunction with the G-2, should develop specific guidance - a definitive order on data security is a must.

When considering data access, units should be concerned with the control of data to ensure their accuracy. Each unit must determine who is allowed to retrieve particular data, and what operations they will be allowed to perform with it (i.e. can they read only, or can they add to it, delete it, or change it in any other way?). A Marine who is unaware of standard procedures may unintentionally introduce errors into a database which could eventually lead to serious consequences, especially when considering microcomputer use in support of sophisticated weapon systems.

This consideration leads naturally into the issue of back-up and recovery procedures. The development of a workable system requires the ability to detect and correct erroneous data input. The WISMO should incorporate these considerations in the development of training programs for system users and programmers.

There is also a need for definitive guidance regarding the aspect of hardware system management. The WISMO should publish a maintenance plan that clearly states what level of maintenance the users are allowed to accomplish and what will be done by other sources. It should also specify preventative maintenance procedures. MAG 39 appears to have a successful PM program which could easily be adapted for Wing wide use. Microcomputer applications are expanding rapidly and deployability of microsystems should be a serious concern. The possibility of limited organic repair capability needs to be explored. A system for configuration management should also be developed to ensure adequate control of hardware assets and maximum utilization of their potential.

4. Microcomputer Training Plan

One of the basic tenets of Marine Corps leadership is to ensure that personnel are properly trained so as to be technically proficient in order to accomplish their assigned mission. The idea of mission oriented training permeates the Corps. The nature of modern technological developments requires an understanding of the basic principles behind the operation of associated equipment. An understanding of how the equipment works is usually required before the Marine is allowed to operate it or perform maintenance on it; it should not be any different with the Zenith microcomputer systems. If a Marine's job requires the use of a microcomputer, then the Marine has a right to expect proper training. The use of microcomputers to solve problems or perform routine tasks requires a fundamental understanding of how the system operates. The expression "user friendly" is a misnomer and should not be relied upon when one is concerned with the operation of high tech items that are essential to

the accomplishment of the Wing mission. A comprehensive training plan should be developed and implemented for those Marines who work with the Zenith microcomputer systems in the 3rd MAW. After the basic principles are taught, then and only then, should consideration be given to the application of computing power to the problem solving process and accomplishment of mission critical tasks.

The number of current and projected microcomputer assets used in support of aviation logistic functions mandates the establishment of an effective training program that encompasses the basics of microcomputing. This program needs to start at the lowest level of the organizations that use the systems, and progress up the chain of command so that the leaders also understand their potential applications. The fundamentals of how the microcomputer works and an understanding of its capabilities is basic knowledge critical to the successful implementation and use of such things as database management systems and spreadsheet applications. Once all personnel involved with the microcomputer have received this basic instruction, then selected individuals in each group should be taught the popular theories about systems design and programming of microcomputers. This will stress the point that the simple operations of the system should be segregated from the program and application design process.

A basic training plan should include, but not be limited to, the following points.

- Principles of microcomputer functions and their potential application.
- Purpose and function of the operating system.
- Essential operational and technical skills.
- Basic maintenance procedures.
- Data security, data access, and back-up/recovery procedures
- Systems design skills for selected individuals
- Programming skills for selected personnel (to include software maintenance).

As previously indicated, these points do not encompass all topics that need to be covered in the training plan, but they do provide a starting point for developing technical competence. The issue of adequate training for microcomputer users cannot be ignored. As time passes technology continues to advance, and all elements of the Wing organization will have tremendous computing power at their disposal. The effectiveness of unit leaders could well rest upon on how well they implement and employ this surging technology.

B. FUNCTIONAL APPLICATIONS FOR AVIATION LOGISTICS SUPPORT

The majority of microcomputer applications in the 3rd MAW exist within the realm of aircraft maintenance and material support. The leaders of these staff functions within the various Groups and the ALD must provide direction and purpose to the use of microcomputer systems for aviation logistic support.

1. The Steering Committee

The steering committee is a viable tool available to the manager/leader for purposes of planning and control. The steering committee has been used as a guidance tool for large data processing entities on a continuing basis, with some minor modifications it is a concept that can be readily adapted to the microcomputer environment. In particular, it can be utilized in helping to recognize the type of information environment that is being fostered in a unit, as well as to assist in the evaluation of which phase or phases an organization is in as far as the computer growth cycle is concerned. When dealing with a new technology, particularly a relatively complex technology, an organization cannot be left to wander from one application to another. The use of experts in complex technology is often recommended, but not all organizations have them available. The steering committee can be a workable alternative to such expert advice, it may even be the preferable method, as an expert may not be thoroughly familiar with the operations of the enterprise. An expert may at times be hampered by a restricted perspective of the environment. The steering committee, if properly staffed, can offer a holistic approach and provide a balanced opinion to often difficult questions. Not only must the committee be composed of the proper mix of people, but it must also ensure that it considers only those problems or questions that it has been given a charter to examine. [Ref. 22]

The steering committee should reflect the following characteristics:

- The committee should have authority to consider and decide data processing priorities that are concerned with microcomputers.
- The committee should be composed of personnel who are responsible for making key decisions in the user area of concern, overall data processing, and organizational planning.
- The committee should provide direction to fully support the organization needs in the area of information resources as far as the capabilities of microcomputers are involved.
- The committee should focus on matters regarding general guidelines and policies that accurately reflect the direction, goals, and objectives of the unit.

We do not mean to propose that the implementation of the steering committee will be a panacea for all of the problems we have pointed out in our study. Although this concept, when properly employed is a useful tool, there are some pitfalls associated with it. Care should be exercised in the education of the committee members. They must be willing to allow each other to freely state their opinions. If individual members are stifled this can lead to self-censorship and the curtailment of dissenting opinions which may be valid. The members must also maintain a high degree of flexibility and at the same time fully understand the dynamics of group decision making. If this is not accomplished the end result could be what Irving Janus has labelled an ailment called "groupthink" - i.e. the members could see the committee as being invulnerable and then rationalize that the committee has made the right decision, because it is not possible for them to be "wrong". [Ref. 20: page 327]

Although group decision making has its problems, we feel that it can be an effective tool for the Assistant Chief of Staff for Aviation Logistics to use in developing a capable system for aircraft maintenance and material support in the 3rd MAW. Based upon the demands of functional and mission requirements, we realize that there are often severe time constraints placed upon members of the organization; however, the importance of the Zenith microcomputer as a managerial tool must be given due consideration. A steering committee, if properly staffed, can help in the development of organizational excellence. We think that The Maintenance Officer and the Wing Supply Officer should be key members of this committee as they both should have an appreciation of the "big picture" in the aviation logistics support arena. We also think that the AMMO and GSO of each of the Groups should be included on the steering committee. We are making this recommendation based upon their breadth of knowledge, and their level of influence in their parent organizations; the AMMO and GSO should have a feeling of where their unit is and where it is heading in the future. We would also add the following caution - it is essential that these committee members develop a solid awareness of microcomputer capabilities.

2. Information Systems Environment and Phase of Computer Growth

The ALD and each of the Groups in our study are currently unique in their information systems environment and phase of computer growth according to the Nolan model. The mission of the Wing, as the major system in our analysis, is accomplished through the integration of the missions assigned to the Groups. There is a distinct difference between each of the Groups in our study because of the type of

aircraft they operate. Because of the difference in equipment, there will naturally be some variation in the degree of operational readiness that each is able to achieve. These variations are a result of the age of the equipment, the state of the technology when those systems were developed, the overall integrated logistic support structure for those aircraft within Naval Aviation, and a host of other factors. Despite these differences their is a commonality of purpose in aircraft maintenance and material support, and standardization of procedures is an important factor in achieving the established goals for operational readiness. This is one of the primary concerns of the Naval Aviation Maintenance Program.

Based on this precedent, we suggest that it is important to standardize and stabilize the information systems environment and phase of computer growth for aviation logistics support across the Wing. Not only can this standardization of computer applications contribute to the enhancement of operational readiness, but a common understanding and use of computer technology for aircraft maintenance and material support provides an effective tool for the development of functional skills. If standardization was a reality, as Marines go from one job to another and serve with different units in the course of their careers they would not be faced with major problems in learning a new system or relearning the old way of doing things. A standard information systems environment and phase of computer growth can also help to promote an understanding of computer technology across the Wing and may, in fact, encourage new initiatives and applications. A common view of the importance of microcomputers would also serve to alleviate any problems arising from perceived environmental dissonance.

In considering any moves toward standardization of a system all aspects for the existing individual systems should be considered. Although one particular Group may have a general plan that provides a model for the desired standard, there may be singular aspects of programs in other Groups which should be incorporated in any standards that are developed. The steering committee should review the program of each Group and determine which aspects of each program, if any, should be incorporated in an overall standard for the Wing. Based on our observations, we think that MAG 11's computerization plan represents the most effective and comprehensive scheme for automation of aviation logistics support functions, and we recommend that it be used as the framework for developing a Wing standard. We further suggest that the Information Systems Environment and Phase of Computer Growth which existed

in MAG 11 be used as the baseline for development of the Wing program. Achieving this baseline and developing standards will not be easy; it will require a great deal of planning and flexibility.

3. Standard Applications for Aviation Logistic Support

In terms of standard applications for aircraft maintenance and material support, MAG 11's Preliminary Computerization Plan (Appendix B) provides a general outline for development. The steering committee should consider a similar plan that involves personnel from the ALD and each Group in a Wing Computer System Development Team. The team should consist of a System Development Coordinator, a System Development Group, a System User Group and Programmers. The Coordinator and the System Development Group should review existing applications, determine requirements for new applications, and prioritize the development effort considering current needs and future automated capability (i.e., NALCOMIS).

4. Training Needs

Based upon the personnel needs of each Group and the necessity to maintain a proficient system development team, the steering committee should consider the microcomputer training requirements for personnel involved in aviation logistic support with regard to the number of personnel requiring training, and the type of training desired. These requirements should be provided to the WISMO as a basis for the microcomputer training plan. Each Group should coordinate the scheduling of training with the Group ISC who in turn will coordinate the actions with the WISMO.

C. SUMMARY

When we began our research we focused on three main areas of concern: the impact of microcomputers on the structure and organizational behavior of those elements in the 3rd MAW concerned with aviation logistic support; the methods of microcomputer implementation and their effectiveness; and the types of problems which have evolved as a consequence of this new technology. The lessons we learned during the course of our study were more involved than we had originally anticipated.

The structure of the organization and the resultant relationships are changing. The WISMO is emerging as a more important element of the overall Wing organization, and the nature of the technology they govern will eventually involve them in every aspect of mission support. The Information Systems Coordinator also has an emerging role which will take on greater significance as unit leaders become

aware of the benefits to be derived from microcomputer applications. The idea of a System Development Team made up of a coordinator, a development group, a user group, and programmers is beginning to take shape in at least one Group, and the number of applications that exist throughout the Wing suggests some type of organizational framework in every other Group.

The methods of microcomputer implementation and their effectiveness in each subsystem are truly diverse. The employment of microcomputers for aviation logistic support in the 3rd MAW was a matter dictated by higher authority, and their implementation and use in each of the various subsystems that make up the Wing was largely determined by individual initiatives. A comparison of the situation in 3rd MAW with the basic guidelines of the general implementation model we chose for our analysis suggests that more planning and greater user involvement may have provided a more effective beginning to the automation of aviation logistic support functions.

The introduction of any new technology or method of operation brings new problems to the organization. The implementation of microcomputers in the 3rd MAW has provided its leaders with a new tool that can revolutionize the way they conduct operations. This is a new frontier that requires exploration. Some existing principles of management and leadership may have to change. This raises many questions and suggests areas for further research: Who should have a microcomputer? Who should operate it? How does their use impact on the leadership role of the Officer and the Staff NCO?

In the last few years our colleges and universities have recognized the growing importance of computer technology in every facet of our lives. Many have instituted programs which require new students to purchase and use microcomputers as a part of the educational process. Even our high schools are providing education in computer applications. Future Marines should be better prepared to work with automated systems, but the process of merging this technology with the mission requirements of the Marine Corps must begin today. How much computer knowledge does our education system now provide, and what type of training programs does the Marine Corps need to develop to provide future Marines with the necessary skills to accomplish their mission in an increasingly automated environment? The answers to these questions would provide guidance to the Marine Corps in the allocation of its training resources.

Change is constantly occuring. As we began our analysis of the case, the units we studied were all in transition, but the process is slow, and the methods are not systematic. Much work remains to be done if the 3rd MAW wishes to exploit the full potential of microcomputer technology.

APPENDIX A
QUESTIONNAIRE

Read each question carefully and circle the appropriate response. Some questions may have more than one appropriate response; circle all that apply. Please feel free to comment on any of the questions.

1. What type of unit are you assigned to?

   A. Headquarters & Maintenance Squadron (H&MS).

   B. Flying Squadron

   C. Wing Staff

   D. Other (Indicate unit)

2. What functional area do you work in? (Indicate which shop in area after your response.)

   A. Avionics

   B. Maintenance

   C. Ordnance

   D. Supply

   E. Other

3. What is your rank? (Indicate your MOS in the area after your response.)

   A. O4 or above

   B. O1-O3

   C. E6-E9

   D. E4-E5

   E. E3 or below

4. What type of microcomputer(s) do you have in your shop? (Indicate the quantity in the area after your response.)

   A. Zenith 120

   B. Zenith 150

   C. IBM - XT

   D. IBM - AT

   E. Apple

   F. Other (Indicate type)

5. Did you receive formal guidelines in writing that told you how to set up the microcomputer and use it in your shop?

A. Yes

B. No

6. How long have you had each microcomputer in your shop? (You may have more that one response if you have more than one microcomputer.)

A. 1 - 3 months

B. 4 - 6 months

C. 7 - 9 months

D. 10 - 12 months

E. More than one year (Indicate approximate number of months ___).

7. How did you acquire your microcomputer?

A. We heard they were available, so we requested one.

B. We saw what other shops that had microcomputers were doing, so we requested one.

C. We never asked for one, it was just given to us.

D. Other. (Explain briefly)

8. What do you use the microcomputer for?

A. Word Processing

B. Storage of job related files

C. Manipulation of data (for example - use of software such as DBASE II and Lotus 1 - 2 - 3, or programs written in Basic or Pascal).

D. Other. (Explain briefly)

9. Which software do you use?

A. Wordstar

B. DBASE II

C. Lotus 1 - 2 - 3

D. Other (List other software you use)

10. How did you obtain this software?

A. It was issued with the computer.

B. We got copies from another unit.

C. Someone in our unit has a personal computer and made a copy of software they own.

D. It was given to us by a higher command for use in processing required reports.

E. Other. (Explain briefly)

11. What languages were used to write programs for jobs that you run in your shop?

A. Basic

B. Pascal

C. Fortran

D. Other (List)

12. How did you obtain your programs?

A. They were written by someone in our unit.

B. They were given to us by a higher command.

C. We got a copy of a program from another unit that does similar things.

D. They were purchased directly from vendors.

E. Other. (Explain briefly)

13. Where did your Marines learn how to use microcomputers?

A. Formal Marine Corps School

B. Commercial training requested by your unit.

C. On the job training.

D. Prior education / experience outside of the Marine Corps.

E. Vendor tutorials / self taught from available manuals.

F. Other. (Explain briefly)

14. List the rank and MOS of all Marines in your shop that use the microcomputer.

NUMBER********************RANK*****************MOS

15. Do you have access to preventative maintenance procedures for your microcomputer?

A. Yes

B. No

16. Who performs preventative maintenance on your microcomputers?

A. One person is designated to perform preventative maintenance on all microcomputers in the command.

B. We have someone in our shop designated to perform preventative maintenance.

C. We do not do preventative maintenance on our microcomputers.

D. Other. (Explain briefly)

17. On the average, how many hours per day is your microcomputer used?

A. Less than 1 hour.

B. 1 - 2 hours.

C. 2 - 4 hours.

D. 4 - 6 hours.

E. More than 6 hours (Indicate approximate number of hours per day____).

18. Are there times during the month when your microcomputer is used for longer than the normal time period, for example at the end of the month when a lot of reports may be due?

A. Yes. (Indicate when and explain briefly)

B. No.

19. Based on how much you use your microcomputer(s), is it adequate for your needs?

A. Yes.

B. No. (Explain briefly)

20. Who reviews the output of your microcomputer?

A. Officer in charge - output is used for internal shop management.

B. Squadron Commanding Officer.

C. Group Staff Officers (for example Group Supply Officer or Group Maintenance Officer).

D. Group Commanding Officer.

E. The Commanding General and his Staff.

F. Other. (Indicate who ________________)

21. What types of computer files do you maintain?

A. Personal data on your Marines.

B. Training records.

C. Required reports

D. Inventory records.

E. Other.(List)

22. Do you have access to any written orders pertaining to the use of your microcomputer?

A. Yes.(cite reference ________________).

B. No.

23. Please list all the programs you use and briefly describe the jobs and required reports you do with each program. (For example: AMPIS - used for muster reports, recall rosters, fitness reports, and other personnel type reports and information.)

APPENDIX B
PRELIMINARY MAG 11 COMPUTERIZATION PLAN

This appendix contains the proposed computerization plan for Marine Aircraft Group 11.

GOAL

To develop a system for the integrated and coordinated utilization of the computer as an aid in the collection, processing and manipulation of information required to efficiently support MAG-11's aircraft maintenance effort.

Computer System Development Personnel

A. System Development Coordinator (Z120 Officer). An officer will be assigned by the Group Aircraft Maintenance Officer to:

- Oversee overall system development
- Coordinate hardware/software acquisition/ upgrade/distribution.
- Set system development priorities.
- Coordinate developed system distribution/usage.
- Schedule and officiate design/user group meetings.

B. System Development Group. An experienced, knowledgeable SNCO from each division/squadron will be assigned by each division officer/squadron Aircraft Maintenance Officer to:

- Identify/coordinate division/squadron needs.
- Review and verify system development as it progresses.
- Interact with programming efforts to provide needed insight/experience and ensure development provides maximum data manipulation and useability.
- Provide communication between development group members on matters pertaining to system integration/compatibility.

C. System User Group. Actual systems user personnel assigned in each division to:

- Identifies system use problems.
- Provided communication between user group members on matters pertaining to system utilization.

D. Programmers. A primary MAG-11 programmer will be assigned by the group AMMO to:

- Provide the bulk of programming requirements.
- Provide training for alternate programmers.

- Review test all system programs to ensure compatibility, integration, workability,and adherence to overall system development plan.

Computer System Requirements

- All programs will be written utilizing DBASE II.
- All programs will be menu driven and will be "plugged in" to each division squadron system skeleton.
- All programs will be written utilizing a "user friendly environment" philosophy to minimize user training requirements.

Plan of Action

A. Introduce the System

- Define preliminary goal and direction
- Provide overview of system development procedures.
- Define system development group assignments.
- Distribute and discuss system development preliminary plan.
- Request system development input.

B. Initial system development group meeting

- Collect and define needs

C. Design system on paper.

D. Review system on paper with system development group

E. Make changes required write preliminary test system skeleton.

F. Run system for system development group.

G. Review, make required changes, test for validity.

H. Begin modular system development.

- System Coordinator sets priority and identifies system development group members involved.
- Programmer and identified system development group members work together to write system modules.
- Module is tested by primary user.
- User group member identifies problems.
- Module is rewritten and again tested.
- System Coordinator, identified system development group members and test user perform post run review.
- When found to be valid., program is distributed by the System Coordinator to all users.

I. System Coordinator writes and makes necessary changes to system user manual.

J. System development group and system user group meetings occur periodically.

- Review system problems.
- Makes changes to system as necessary.

- Control/coordinate expansion of system.

Preliminary Startup Procedures

1. Review list of identified program modules.
2. Utilizing Program Module Development Proposal Form, comment on already identified program modules or add information on desired program modules not listed.
3. Submit Program Module Development Proposal Forms to the Z120 Officer.
4. Submissions should be made by 1 September1986.

System Excluded Tasks

1. Technical Training Lesson Plans.
2. MI/GMI's
3. Daily Correspondence/Memos
4. SESS

System Included Tasks

1. On line help instructions
2. Desktop procedures for each module.
3. Password change
4. Programmer exit
5. Data transfer programs(as required).

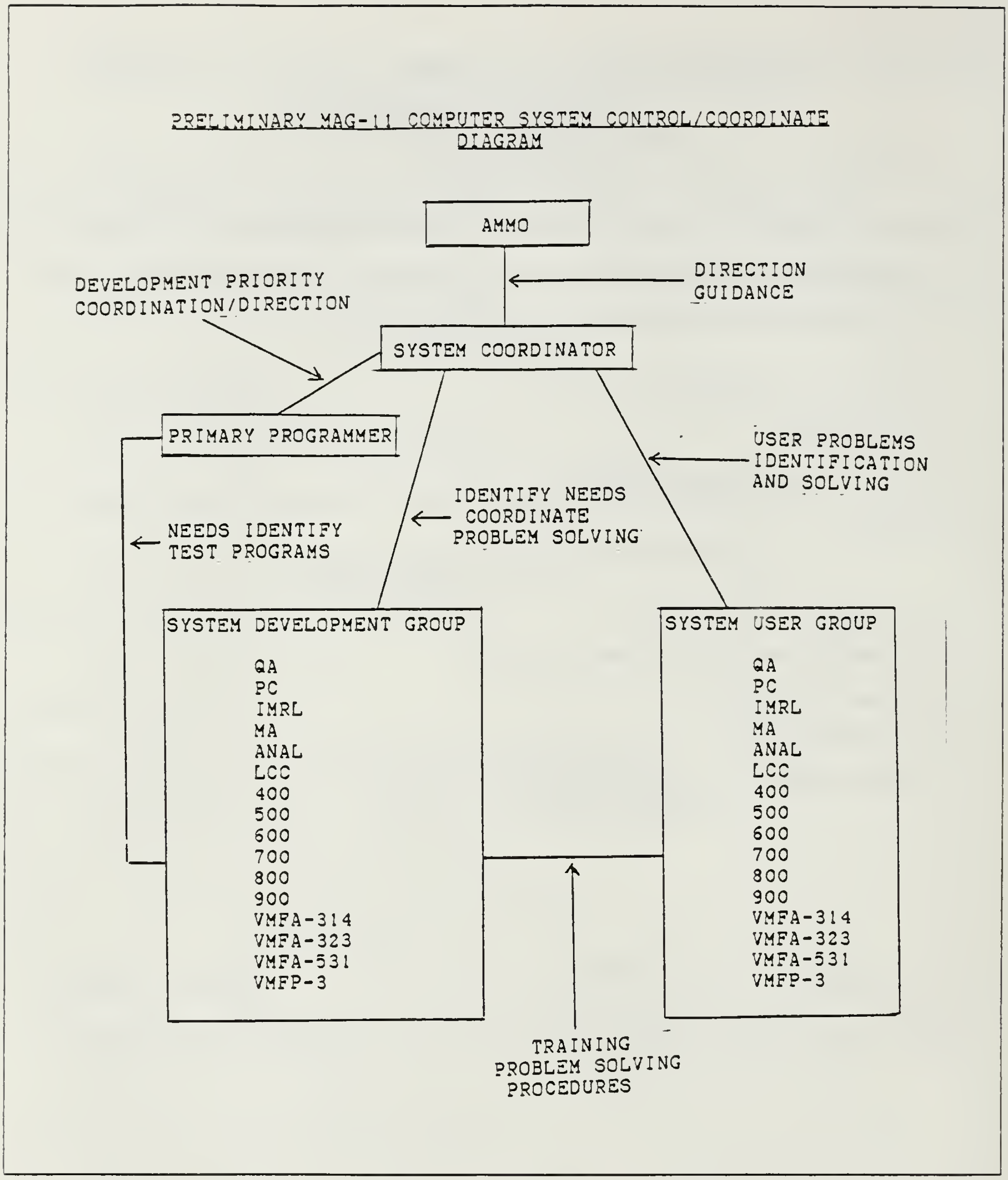

Figure B.1 Computer System Control/Coordinate Diagram.

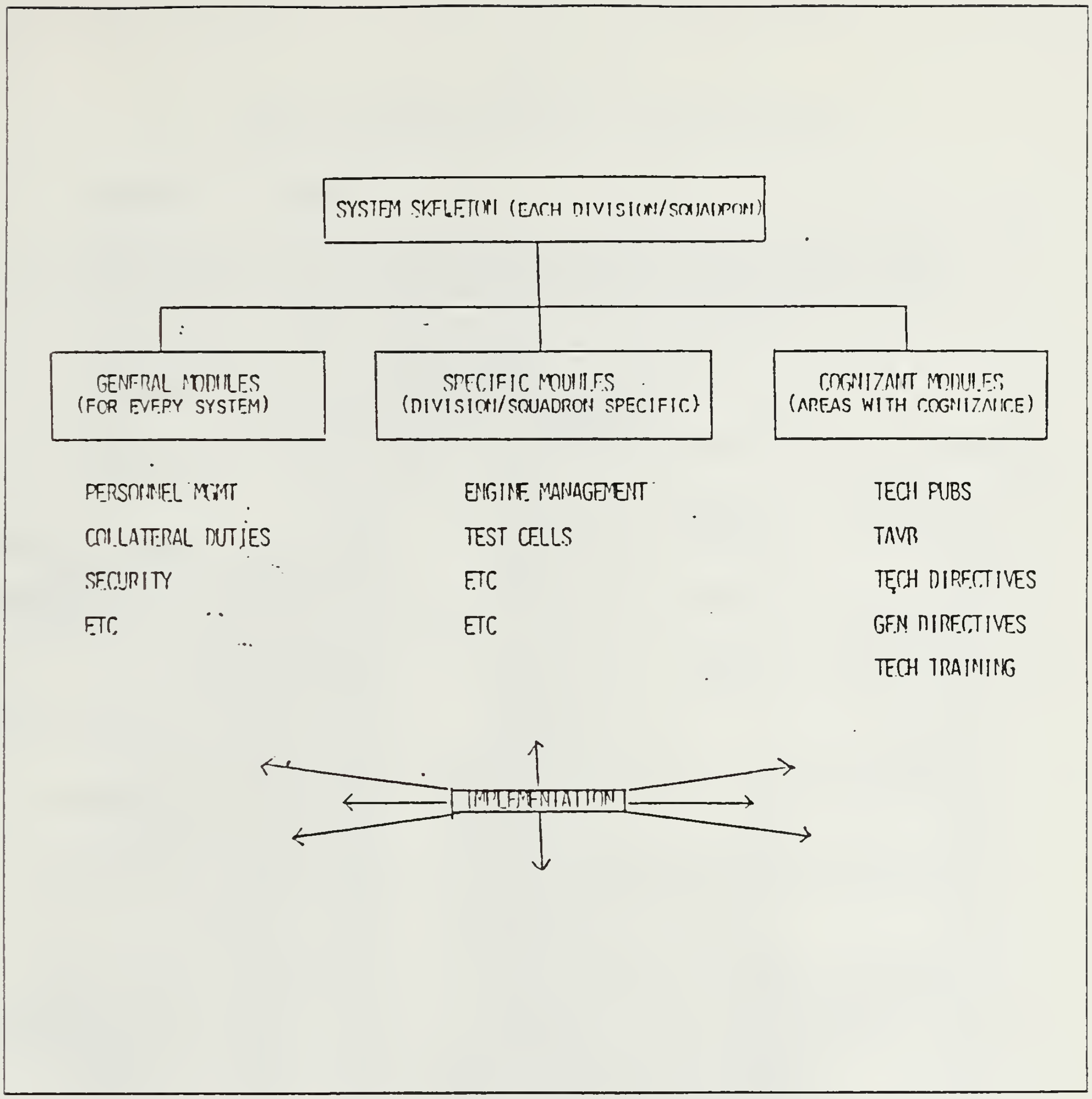

Figure B.2 Sample System Skeleton.

TABLE 11

PRELIMINARY COGNIZANT MODULES LIST

MODULE NAME	COGINIZANT	APPLICATION	PURPOSE
TDC	PC (MMP)	ALL (INFO)	TRACK/PROVIDE INFO ON TECH DIR COMPL
TPL	QA	ALL (UPKEEP)	TRACK/PROVIDE INFO ON TECH PUBS
CDI	QA (MMP)	ALL (INFO)	TRACK/PROVIDE INFO ON CDI ASSIGNMENT
TOOL CONTROL	PC	ALL PROD (UPKEEP)	TRACK/PROVIDE INFO ON TOOL CONTROL
LETTER TYPE DIR	MA (MMP)	ALL (INFO)	TRACK/PROVIDE INFO ON DIRECTIVES
PM	PC (MMP)	ALL (UPKEEP)	SCHEDULE/TRACK PM
AUDIT PROGRAM	QA	ALL (ANSWER)	AUTOMATE QA AUDIT PROGRAM
MI/GMI	QA	ALL (INFO)	MONITOR/PROVIDE INFO ON GMI/MI STATUS
CORR CONT	AF	AVI (UPKEEP)	MONITOR/SCHEDULE CORR CONTROL
HAZ MATL	SE	ALL (INFO)	MONITOR HAZ MATL DISPOSAL
PRODUCTION RPTS	PC	SAT PC (UPKEEP)	PROVIDE PRODUCTION STATISTICS
TAVB	990	ALL (UPKEEP)	PROVIDE VAN STATUS/INFORMATION
IMRL	IMRL	ALL (UPKEEP)	PROVIDE IMRL INFORMATION
SHELF LIFE	QA	ALL (UPKEEP)	MONITOR SHELF LIFE PROGRAM
FUEL SURVEILL	PP	QA (INFO)	MONITOR FUEL SURVEILL PROGRAM
MRC	PC/QA	ALL (INFO)	MONITOR LOCAL MRC DECKS
ICRL	PC	ALL (UPKEEP)	MONITOR ICRL PROGRAM
MAINT PLAN	MA	ALL (INPUT)	AUTOMATE MAINT PLAN ISSUANCE
TRACKING CAL	LCC	ALL (INFO)	PROVIDE EVENTS STATUS
CALIBRATION	PME	ALL (INFO)	MONITOR/PROVIDE INFO ON CAL REQ
TURNOVER JACKET	MA	ALL (INFO)	PROVIDE GENERAL TURNOVER JACKET INFO
ABO	ALSS	SQDN (INFO)	MONITOR AIR BREATHING OXY PROGRAM
ORD CERT	ORD	SQDN (INFO)	MONITOR ORD CERT/TRNG PROGRAM
PEB	PC	ALL PROD (UPKEEP)	MONITOR/PROVIDE INFO ON PEB

TABLE 12

PRELIMINARY GENERAL MODULES LIST

MODULE NAME	PURPOSE
PERSONNEL	PROVIDE DIV/SQDN PERSONNEL INFORMATION AND OUTPUT PERSONNEL ROSTERS
COLLATERAL DUTY	PROVIDE ASSIGNMENTS/LETTER GENERATION FOR COLLATERAL DUTIES
MILITARY TRNG	PROVIDE DIV/SQDN PERSONNEL TRAINING INFORMATION
TECH TRAINING	PROVIDE TECH TRNG LESSON HISTORY/REVIEW STATUS/INPUT TO MMP
SECURITY	PROVIDE PERSONNEL SECURITY CLASS/ACCESS INFO
CLASS MATL CONT	PROVIDE CLASSIFIED MATERIAL CONTROL INVENTORY TASKS
SERVMART	PROVIDE SERVMART ORDERING INFORMATION
EMBARKATION	PROVIDE EMBARKATION INFORMATION
AMRR	AUTOMATE ACFT MATL READINESS RPT
BLANK FORMS	PROVIDE AUTOMATIC PRINTOUT/STANDARDIZATION OF LOCALLY PRODUCED FORMS
REPORTS CONTROL	AUTOMATE REPORTS CONTROL

TABLE 13

PRELIMINARY IDENTIFIED SPECIFIC MODULES LIST

MODULE NAME	APPLICATION	PURPOSE
PLANE CAPTAIN	SQDN (MMP)	MONITOR PLANE CAPTAIN ASSIGN/TRNG INFORMATION
HIGH PWR TURN	SQDN (MMP)	MONITOR HI POWER TURN AUTHORIZATIONS
APU	SQDN (MMP)	MONITOR APU AUTHORIZATIONS
NAMDRP	QA	MONITOR NAMDRP
FOD	PP	MONITOR/AUTOMATE FOD REPORTING
TBOS	AVI	AUTOMATE TEST BENCH STATUS REPORTING
ENGINE MGMT	PP	PROVIDE ENG/MODULE STATUS/INFORMATION
EXT TANKS	PP	PROVIDE EXTERNAL TANK STATUS/INFORMATION
TEST CELL	PP	PROVIDE TEST CELL STATUS/INFORMATION
SRC/EHR	ALL	PROVIDE SRC/EHR INFORMATION/STATUS
HUSH HOUSE	PP	PROVIDE HUSH HOUSE INFORMATION/STATUS
SE AVAIL	SE	PROVIDE SUPPORT EQUIP AVAIL STATUS
SE CUST INVENT	SE	PROVIDE SUP EQUIP CUSTODIAN/INVENTORY INFORMATION
WORK REQUESTS	LCC	PROVIDE INFORMATION ON WORK REQUEST STATUS
AVAIL CRYO	ALSS	PROVIDE CRYOGENICS AVAILABILITY STATUS
GAS CYL HYD	ALSS	PROVIDE GAS CYLINDER HYDRO TEST INFORMATION/STATUS
CAPTIVE CARRY	ORD	PROVIDE AUTOMATED CAPTIVE CARRY INFORMATION/REPORTS
AAMO FILER	AAMO	DATABASED DESK FILING SYSTEM INFORMATION
ACTION MESSAGES	AMO	PROVIDES ACTION MESSAGE STATUS/INFORMATION
Z120 STATUS	Z120 OFFICE	PROVIDES STATUS ON Z120 COMPUTER SYSTEM DEVELOPMENT

APPENDIX C
GLOSSARY OF ACRONYMS

ADP - Automated Data Processing

ADPE - Automated Data Processing Equipment

AIMSO - Aircraft Intermediate Maintenance Support Office

ALD - Aviation Logistic Department

ALM - Aviation Logistic Management

AMMO - Aircraft Maintenance Management Officer

AMO - Aircraft Maintenance Officer

CG - Commanding General

CGFMFPAC - Commanding General Fleet Marine Forces Pacific

CNO - Chief of Naval Operations

CO - Commanding Officer

COMNAVAIRPAC - Commander Naval Air Forces Pacific

CPU - Central Processing Unit

DBMS - Database Management System

FMF - Fleet Marine Forces

FMFM - Fleet Marine Force Manual

FMFPAC - Fleet Marine Force Pacific

FRS - Fleet Replacement Squadron

GASSC - Group Aviation Supply Support Center

GASSCO - Group Aviation Supply Support Center Officer

GSA - General Services Administration

GSO - Group Supply Officer

HMA - Helicopter Marine Attack

HMH - Helicopter Marine Heavy

HMM - Helicopter Marine Medium

IMA - Intermediate Maintenance Activity

IMRL - Individual Material Readiness List

IRC - Information Resources Center

ISC - Information Systems Coordinator

JCN - Job Control Number

LAN - Local Area Network

LCC - Logistics Control Center
MACG - Marine Air Control Group
MAG - Marine Aircraft Group
MCAF - Marine Corps Air Facility
MCAS - Marine Corps Air Station
MCDEC - Marine Corps Development and Education Command
MMO - Maintenance Management Officer
MOS - Military Occupational Specialty
MWSG - Marine Wing Support Group
NALCOMIS - Naval Aviation Logistics Command Management Information System
NAMP - Naval Aviation Maintenance Program
NARDAC - Navy Regional Data Automation Center
NARF - Naval Air Rework Facility
NAS - Naval Air Station
NAVAIRSYSCOM - Naval Air Systems Command
NCO - Non-Commissioned Officer
OPNAVINST - Operations Navy Instruction
PM - Preventative Maintenance
RASC - Regional Automated Services Center
RILSD - Resident Integrated Logistic Support Detachment
RMS - Repairables Management Section
SESS - Support Equipment Standardization System
SNCO - Staff Non-Commissioned Officer
SUADPS - Shipboard Uniform Automated Data Processing System
USMC - United States Marine Corps
VMA - Fixed Wing Marine Attack
VMA(AW) - Fixed Wing Marine Attack (all weather)
VMAQ - Fixed Wing Marine Tactical Electronic Warfare
VMFA - Fixed Wing Marine Fighter Attack
VMFP - Fixed Wing Marine Photographic Reconnaissance
VMGR - Fixed Wing Marine Aerial Refueler Transport
VMO - Fixed Wing Marine Observation
WISMO - Wing Information Systems Management Office
WPE - Word Processing Equipment

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